MODERN PLASTICS

TO THE AMERICAN PEOPLE:

Your sons, husbands and brothers who are standing today upon the battlefronts are fighting for more than victory in war. They are fighting for a new world of freedom and peace.

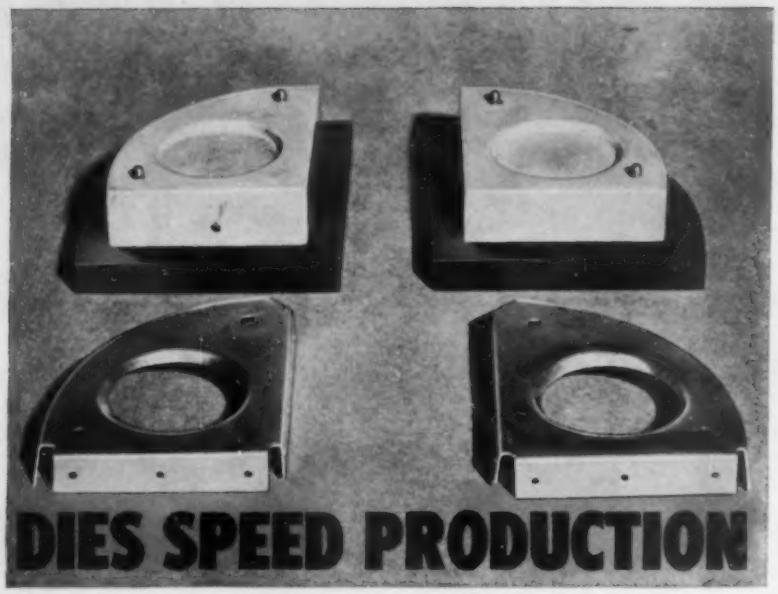
We, upon whom has been placed the responsibility of leading the American forces, appeal to you with all possible earnestness to invest in War Bonds to the fullest extent of your capacity.

Give us not only the needed implements of war, but the assurance and backing of a united people so necessary to hasten the victory and speed the return of your fighting men.

Harry S. Truman — William D. Leahy
Douglas MacArthur — Ernest J. King
Dwight D. Eisenhower — Chester W. Nimitz
H. H. Arnold

JUNE 1945

★ ★ ★ ★ *The Seventh War Loan Drive* ★ ★ ★ ★ ★



CAST PLASTIC DIES SPEED PRODUCTION

This war has advanced plastics' progress by decades. Many new and unusual developments . . developments that border on the miraculous, give the post-victory manufacturer every opportunity for success. Typical of these developments are Durez casting resins . . designed to reduce the time and cost consumed in conventional die-making. . designed to speed production.

Durez casting resins lend themselves readily to cast forms for hydro-press operation. To make a forming die for a hydro-press, the original pattern can be made of wood and a plaster cast mold made from this. The resin is poured in . . . without the need of a core if the part is small . . . and cured. It is then ready for immediate use. The above-illustrated cast plastic dies (and parts which were formed from them) produced hundreds of pieces which were without flaw.

Holds Tolerances

Tests have shown the Durez casting resin used for these dies may be sawed easily, that it drills like hard maple wood, that it will not hold heat or be softened by it, and that it will not ignite. Standard wood or metal working equipment may be used to work it. When it becomes necessary to replace a conventionally made die, it has been found that it is not necessary to wait for a die to be remade in that material. Instead, in some instances, a part formed on the original die may simply be filled with a casting resin and the plastic cured into a usable die in a matter of a few hours. Furthermore, casting resins are particularly adaptable where the form or die has in it joggles or other similar insets which must be machined in the conventional die material. No such machining is necessary in the plastic die. The liquid resin follows the contours of the part exactly and holds those contours to predetermined tolerences.

Other Uses

A few additional uses for these resins are stretch-press dies, jigs, assembly and holding fixtures, foundry patterns, and masking shields for plating.

Folder Available

As specialists in the production of phenolics during the past quarter century, Durez technicians have gained an enviable record for developing plastics that fit the job. This background includes molding compounds, industrial resins and oil soluble resins. The benefits which this wealth of experience can provide are available at all times towards the development of practical industrial applications. Write for authoritative folder on casting resins. Durez Plastics & Chemicals, Inc., 266 Walck Road, North Tonawanda, N. Y.

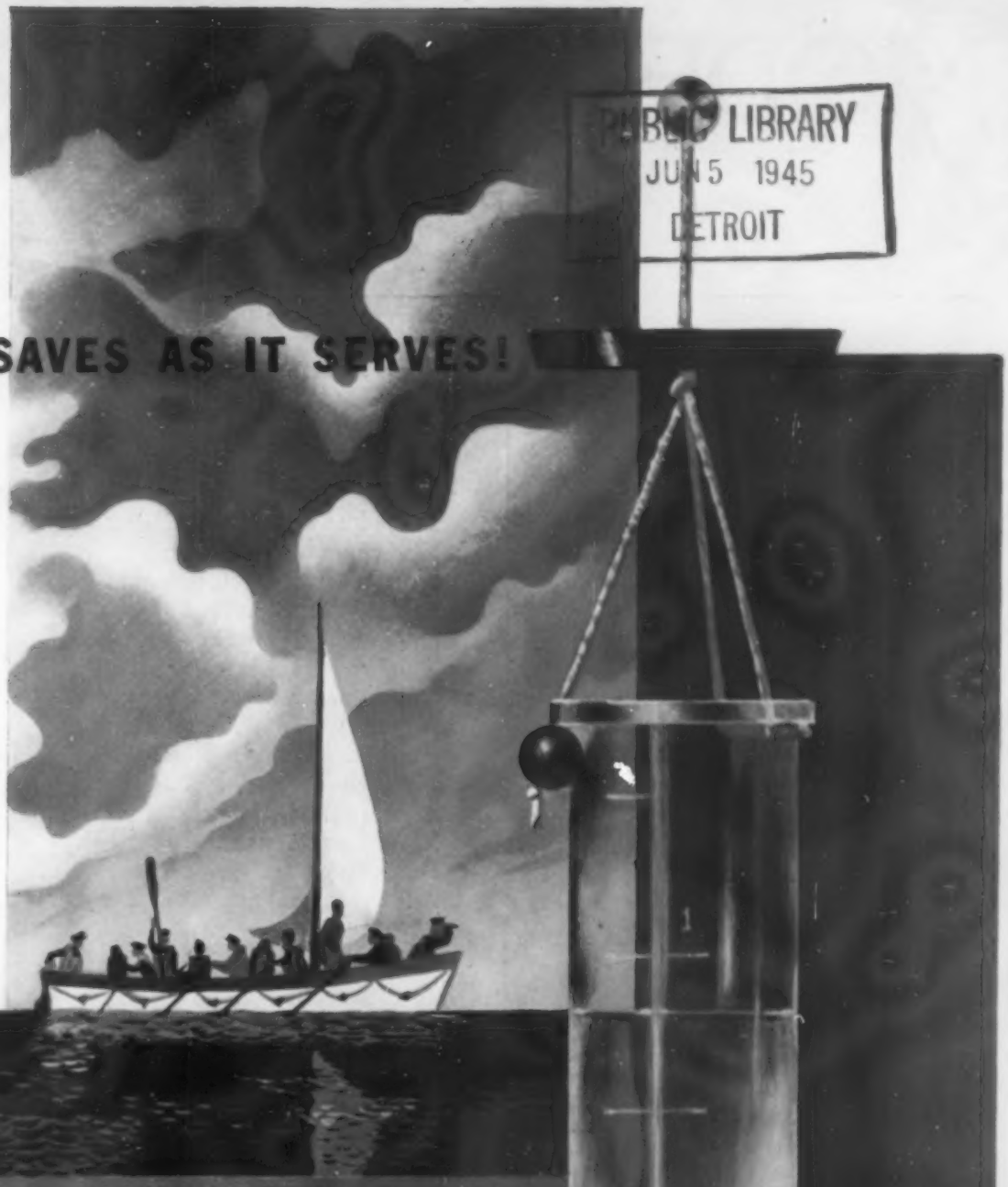
DUREZ

PHENOLIC RESINS

- MOLDING COMPOUNDS
- INDUSTRIAL RESINS
- OIL SOLUBLE RESINS

PLASTICS THAT FIT THE JOB

LOALIN...SAVES AS IT SERVES!



Thus far, Loalin (Catalin polystyrene) has made the closest bid to being "the one plastic best qualified to satisfy the greatest number of production and performance requirements". All Loalin formulations are immune to acids, alkalies and alcohols, absorb the least water, possess high dimensional stability and offer exceptional insulating qualities. (One type resists heat distortion up to 236°F.). Loulin's color range is rich, distinctive, outstanding . . . and, as the lightest of all plastics, Loalin assures the greatest product yield per pound.

It is certain that when restrictions are withdrawn, Loalin will make up for the period during which its essential ingredients were allocated to the service of war's more vital requirements. Catalin's technical staff, during the interim, will be glad to outline the various types of Loalin and indicate to you some of the many new uses for this versatile, economical plastic material. Inquiries invited!

CATALIN CORPORATION, ONE PARK AVE., N.Y.16, N.Y.

CAST RESINS • LIQUID RESINS • MOLDING COMPOUNDS

Part of a lifeboat's equipment includes the "Waterationer" (pictured above). It was injection molded of Loalin by Maurice A. Lichten Co.,

MODERN PLASTICS

AND PLASTICS

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All editorial contents bearing on military subjects have been released for publication by the Armed Services.

MODERN PLASTICS is regularly indexed in the Industrial Arts Index.

Member Audit Bureau of Circulations

EXECUTIVE and EDITORIAL OFFICES: 122 E. 42nd St., New York 17, N. Y. WASHINGTON 6, D. C., OFFICE: 625 Colorado Bldg., 14th & G Sts. Published the 20th of the preceding month by Modern Plastics, Incorporated. Publication Office, Twentieth and Northampton Sts., Easton Pa., Subscription price $5.00 per year, $8.00 for 2 years in U. S., its possessions and South America. Canadian subscriptions $5.50 per year, $9.00 for 2 years, all other countries $6.00 per year, $10.00 for 2 years, payable in American money or its equivalent. Price 50¢ per copy.

Printed in U. S. A. Entered as second class matter, May 28, 1940, at the Post Office at Easton, Pa., under the act of March 3, 1879. Member of the Audit Bureau of Circulations. Back numbers 3 months or more preceding current issues, when available, $1.00 each.

VOLUME 22 JUNE, 1945 NUMBER 10

General Section

Plastics—Engineering Section

Technical Section

News and Features

Another application that suggests interesting and important uses in all fields

THAT lovely lady probably doesn't give a hoot what the handbag is made from. But she's surely interested in the fact that it's easy to keep clean because it's waterproof and washable. She likes it because it resists scuffing and wear despite its softness. And she knows that it won't fade or turn yellow even after continued handling.

These are just a few of the properties that may be imparted to a finished product through the use of GEON polyvinyl raw materials. And they suggest many interesting and important applications.

For example, you can make scuffproof, good-looking, practically indestructible luggage and brief cases; upholstery material that can be left outdoors because it resists the aging effects of weather; water and mildew-proof fabric coatings for rainwear, shower curtains, tents; soles and heels that will outwear leather many times; film, sheet or coatings of GEON for packages that will resist wear, aging, chemicals, foods, tobacco, oils and greases, moisture, heat and cold. All products made from GEON may be brilliantly or delicately colored.

There are applications for GEON in every industry in America. For more complete information write Department II-6, B. F. Goodrich Chemical Company, Rose Building, East 9th and Prospect, Cleveland 15, Ohio.

Geon
Polyvinyl Materials

B. F. Goodrich Chemical Company A DIVISION OF THE B. F. GOODRICH COMPANY

INSUROK cuts costs way down!

—for Motiograph of Chicago!

Motiograph saves at least $2.50 every time they make a rotary stabilizer for the sound head of a motion picture projector—thanks to the use of INSUROK—recommended by Richardson Plasticians. Stabilizer housings are made of Molded INSUROK; the covers, of Laminated INSUROK. The combination holds a flywheel which operates in a special liquid to reduce film flutter and prevent annoying tone distortion.

This outstanding industrial application is typical of the way in which INSUROK Precision Plastics—with their *high mechanical and dielectric strength, lightness, easy workability, and smooth, shiny finish*—are meeting exacting requirements with unusual economy and efficiency. INSUROK is ready to go to work for you on your present or postwar products. Write Richardson Plasticians now for complete information.

Shown Above: Complete Rotary Stabilizer unit, with Molded INSUROK housing—metal insert—and Laminated INSUROK cover. Used by Motiograph, Chicago, Ill.

INSUROK *Precision Plastics*

The RICHARDSON COMPANY

MELROSE PARK, ILL. NEW BRUNSWICK, N. J. FOUNDED 1858 INDIANAPOLIS 1, IND. LOCKLAND, CINCINNATI 15, OHIO
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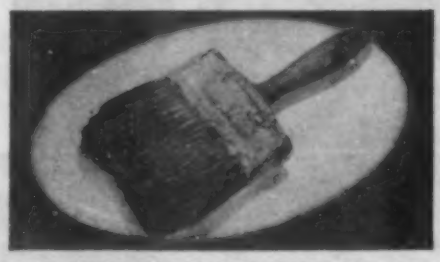
PAINTBRUSH BRISTLES OF DU PONT NYLON

outwear natural bristles by more than 3 to 1... are more resilient... safe with every type of paint



THE OLD WAY: HOG-BRISTLED BRUSH, after painting 23,000 square feet of rough surface, brick and concrete, is about ready to be discarded.

THE NEW WAY: NYLON-BRISTLED BRUSH, used on an equal area of the same type of surface, shows little wear. In another test of abrasion resistance simulating natural painting strokes, a nylon-bristled paintbrush, after one million strokes approximating 840,000 sq. ft. of coverage, wore only ¼ of an inch.

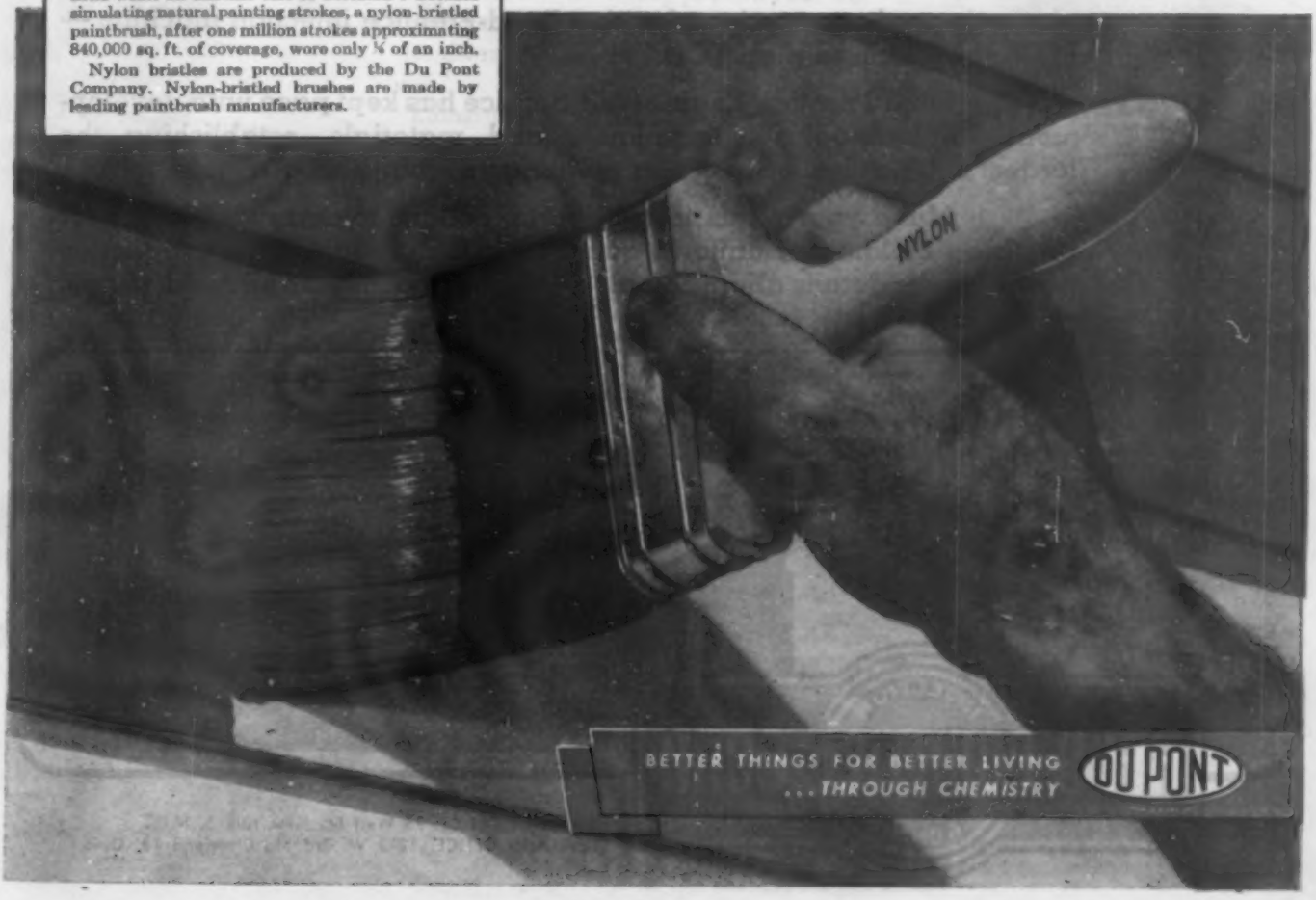
Nylon bristles are produced by the Du Pont Company. Nylon-bristled brushes are made by leading paintbrush manufacturers.

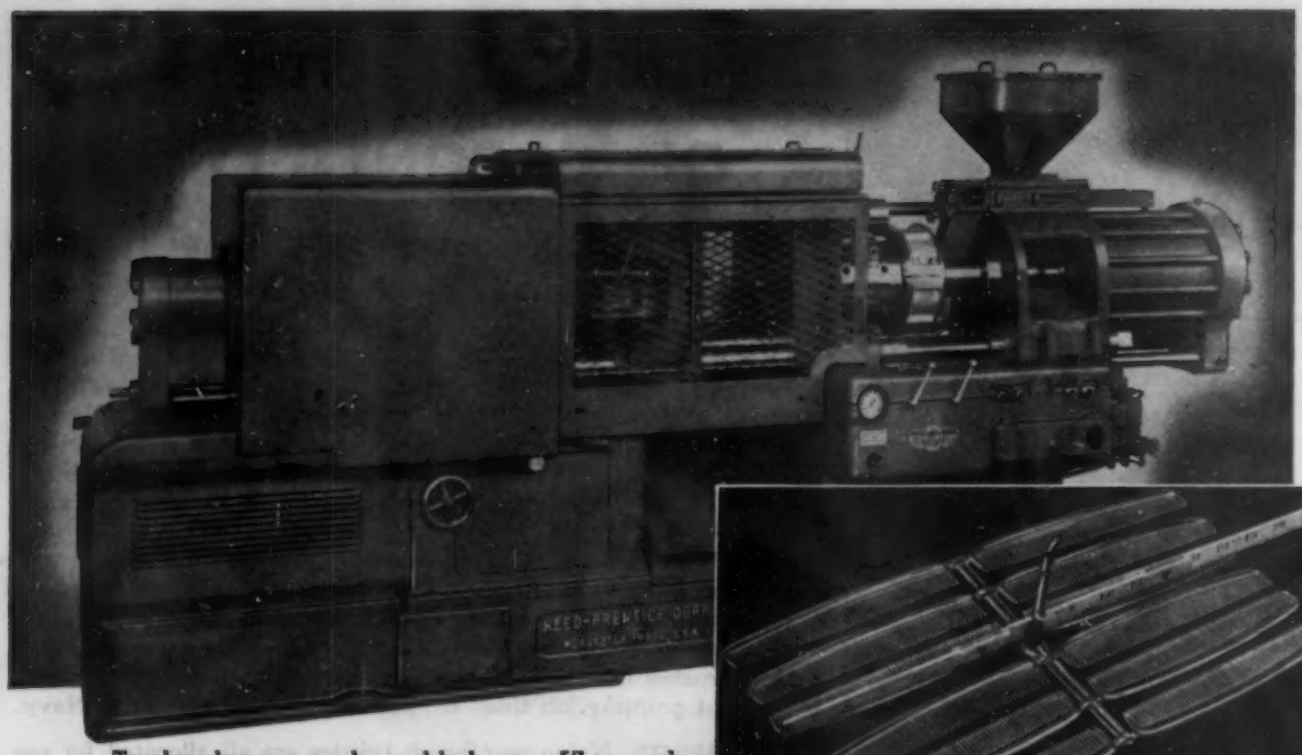
ADVANTAGES: Nylon paintbrush bristles were introduced at just the time they were most needed—when war had cut off the supply of hog bristles. Nylon bristles have conclusively demonstrated that they possess a combination of advantages unobtainable in any other type of bristle, either hog or synthetic. They are not harmed by any kind of paint, lacquer or varnish. They are more resilient than natural bristles and in addition they *last more than three times as long*. Being man-made, their diameter, length and taper are always "as specified," which makes possible the laying on of a smoother, more uniform paint surface and provides better balance and feel in the paintbrush. Over two million nylon-bristled paintbrushes have been taken by Uncle Sam thus far to do the toughest painting job there is—painting ships of the U. S. Navy.

AVAILABILITY: Nylon paintbrush bristles are all allocated for use by the Navy. They are a good example of a Du Pont plastics development of a special material for a special job. For information on nylon and other Du Pont plastics write E. I. du Pont de Nemours & Co. (Inc.), Plastics Dept., Arlington, New Jersey.

FOR PLASTICS.. CONSULT DU PONT

BUY AND HOLD WAR BONDS





Twelve dresser combs molded every 57 seconds by Tilton & Cook Co., Leominster, Mass., on Reed-Prentice 10D-8 oz. injection molding machine (shown above).

A PROFITABLE FIELD FOR TOMORROW

Production possibilities for the civilian market, await the molder of plastic products, equipped with a Reed-Prentice injection machine — PLUS the vision to plan TODAY!

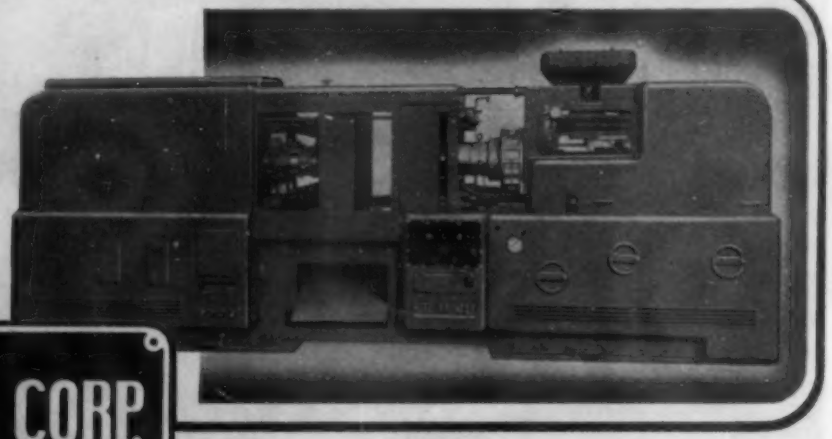
Reed-Prentice Engineered Service has kept pace with developments in thermoplastic techniques and materials, establishing the largest selling line of injection molding machines in America.

Make your plans today, worth dollars tomorrow! Investigate precision molding of uniform quality, plastic products on a production basis. Ask for details about complete range of machines and mold design.

★

Reed-Prentice injection molding machines made in 6, 8, 12, 16 and 22 oz. sizes. (10H-22 oz. machine shown at right.)

★



INJECTION

REED-PRENTICE CORP.

WORCESTER MACHINES MASS., U.S.A.

NEW YORK OFFICE: 75 West St., New York 6, N. Y.
CLEVELAND OFFICE: 1213 W. 3rd St., Cleveland 13, Ohio

CONTACT

Lumarith* Plastics

for items of personal use

LOW THERMAL CONDUCTIVITY is just a laboratory way of saying that Lumarith plastics are inviting to the touch in all temperatures. It explains one of the many reasons why these jade-like thermoplastics are used so frequently in applications involving personal contact and handling: electric shaver housings, hardware, tool handles, telephone handsets . . .

Lumarith molded and fabricated items have a uniform surface texture and smoothness that actually improves with handling. They are odorless, tasteless and non-toxic, and can be produced in a limitless range of colors, color densities and transparencies.

Would you like to know more about these modern plastics? Write for Product Designer's Booklet, or refer to Sweet's Catalog. Celanese Plastic Corporation, *a division of Celanese Corporation of America*, 180 Madison Avenue, New York 16, N. Y.

A Celanese Plastic*

*Reg. U. S. Pat. Off.

Information for Product Designers

Toughness is characteristic of all Lumarith plastics. They have excellent colorability, water resistance, dielectric strength, lightness, uniformity and stability—are interchangeable in many applications. The different Lumarith types and formulations accent particular physical properties in the following manner:

LUMARITH C.A.
Cellulose acetate. The most versatile of the cellulosics . . . ideal in applications requiring balanced physical properties . . . superb color.

LUMARITH X
High acetyl cellulose acetate. Provides added dimensional stability and moisture resistance, with superb color.

LUMARITH E.C.
Ethyl cellulose. Superior toughness at temperature extremes, plus lightness and form retention.

CELLULOID
Cellulose nitrate. Color, economy and all around toughness maintain the popularity of this "first plastic" . . . used in volume for fabricated items.

Success with plastics depends on the proper selection of plastic type and formulation. Our technical staff is at your service.

GLASS

FROM BLUEPRINT CYLINDERS TO COFFEE CUPS

When the armed services needed messware—in mass production quantities and tough enough to stand up under the none-too-gentle handling of a KP or galley detail—they didn't have far to look.

Glass was the logical answer—because of the ruggedness that Corning had learned to put into it. And at Corning the right glass was available . . . and the engineering skill to build and operate the high-speed automatic machinery to produce the tremendous quantities of ware needed.

In sharp contrast to army messware are the huge glass cylinders for blueprint machines around which have rolled the tons upon tons of blueprints for the fighting machines of our armed forces. This is a job for skilled craftsmen, not for automatic production . . . and a job for PYREX brand Glass No. 774, because the cylinders must resist the intense heat of arc lamps and transmit a maximum of light.

Army messware and blueprint cylinders are just two of the many products made possible by Corning's engineering skill, production facilities, and the thousands of Corning glass compositions. They may provide the solution to your problem.

Write Industrial Sales Department MP-6.

CORNING GLASS WORKS
CORNING, NEW YORK

GLASS by CORNING
MARKS AND INDICATE MANUFACTURE BY CORNING GLASS WORKS, CORNING, N.Y.

INDUSTRIAL SALES DEPT., MP-6—
Corning Glass Works, Corning, New York

Please send me a copy of your Bulletin 842—
"*Industrial Glass by Corning.*"

Name..... Title.....

Firm.....

Street.....

City and State.....

When Plastics Come Marching Home

Many plastics problems have been solved under the pressure of war necessity. The knowledge and technique thus gained—of which Stokes has acquired its full share—will become available for the peacetime application of plastics to civilian use the day after wartime restrictions are lifted. If your plans call for the use of plastics or hard rubber, we invite your inquiry.

JOS. **STOKES RUBBER** CO.

Molders of Hard Rubber and Plastics • *Since 1897*

TRENTON, N. J.

In Canada: Jos. **STOKES RUBBER** Co., Ltd., WELLAND, ONT.

A CASE FOR MEDICAL PROGRESS

The Mills-molded Tenite Plastic case for this Clinitest Sugar-Urine Urinalysis set is truly a case for medical progress . . . for it contains another advancement toward the control of Diabetes. This new method of urinalysis provides the diabetic patient with a simplified method of maintaining a more accurate check on his own condition. The Clinitest is a compact, complete unit in itself and eliminates the heating usually needed for urinalysis. Clinitest literature stresses the durability of its plastic case by stating, "The Clinitest case, made of durable TENITE plastic, will last a lifetime with the proper care." Thus the strength of plastic becomes a definite sales asset to this highly specialized product. This effectiveness is a result of Mills' painstaking production analysis. It is typical of the careful attention given all products molded here. Let Mills' planning do the same effective job for your products. We invite your inquiries.

ELMER E. MILLS CORPORATION

Molders of Tenite, Lumarith, Plastacele, Fibestos, Lucite, Crystallite, Polystyrene, Styron, Lustron, Loalin, Vinylite, Mills-Plastic, Saran and Other Thermoplastic Materials

153 WEST HURON STREET, CHICAGO 10, ILLINOIS

Write on your letterhead for the new Injection Molded and Extruded Plastics catalog. Or, for detailed information about [redacted]* pipe, tubing and fittings, write for circulars containing data and illustrations.

*Trade Mark Reg.

KEEPING OUR FEET FAST TO THE GOOD EARTH

IT WOULD BE FUN to take off and tell the world what we have done, seen, heard and dreamed about the future of plastics. But sober second thought tells us that our present job is to stick to producing the plastics that enable us to serve our country best at this time.

But what we are learning now can be of immense service to many concerns who are thinking of their post-war problems in a highly competitive era. We will cheerfully chat with you about your problems and show you how we can serve you.

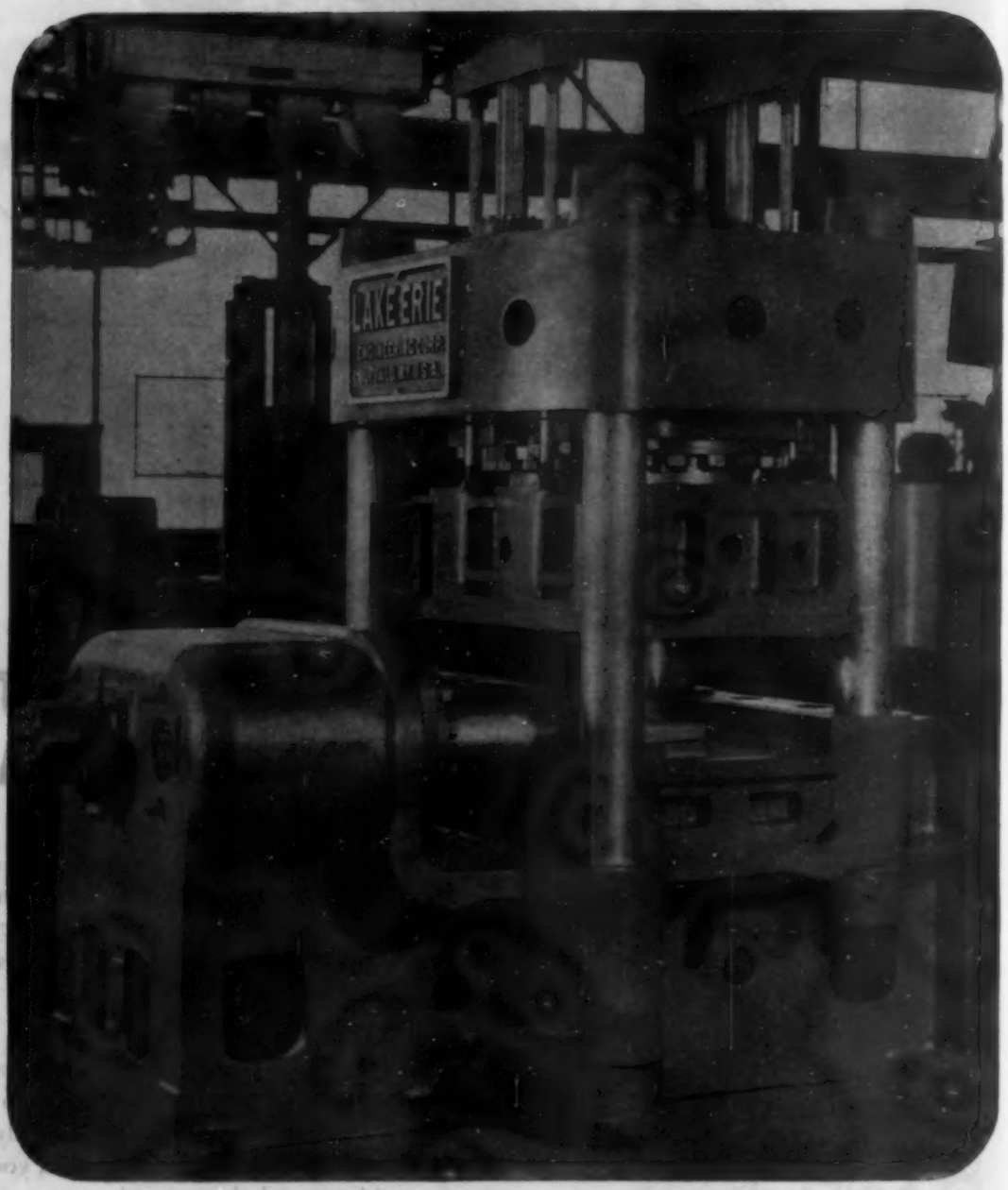
OWENS-ILLINOIS GLASS COMPANY

TOLEDO 1, OHIO

Branches in All Principal Cities

CASE HISTORIES PROVING THE POWER OF THE PRESS

Another Lake Erie contribution to better compression molding



This 450-ton Lake Erie angle molding press was designed and built to meet the customer's specific requirements. It is used by a large electrical manufacturing company for molding phenolic material.

Lake Erie has a thorough knowledge of all types and sizes of hydraulic presses required by the rapidly growing plastics industry.

Already we have designed standard compression molding presses that can be adapted to your needs —or we can build presses to meet any special production methods you may require. Write for complete information.

LAKE ERIE ENGINEERING CORP.
868 Woodward Avenue
Buffalo 17, N. Y.

LAKE ERIE
ENGINEERING CORP.
BUFFALO, N.Y. U.S.A.

LIGHTWEIGHT COCKPIT COOLER...

suggestion for postwar piping or phonograph parts, covers or containers

Economy in large moldings, too, is a trait of the cellulosics. Consider this cockpit ventilator for Republic's Thunderbolt, molded by Pyro Plastics Co., from cellulose acetate. Seventeen inches long, 12 ounces light, it ignores wide temperature extremes, lubricating oil, hydraulic fluid, impact shocks. Injection molding produces the main tube in 45 seconds, the 4-ounce nozzle in 30 seconds.

This suggests a wealth of other applications where one-shot injection, re-use of scrap, ready machining and assembly, lightweight strength and durability, and enduring good looks are your goal.

Lightweight, corrosion resistance, for waste pipes

Bright color, translucency, for automatic phonographs

Colorful, odorless, tasteless, packages and closures

HERCULES

CELLULOSE ACETATE
CELLULOSE NITRATE
ETHYL CELLULOSE

For general-purpose production plastics

Hercules does not make plastics or molding powder, but supplies the high-quality cellulose derivatives from which they are made. For data, please write

HERCULES POWDER COMPANY 916 Market Street, Wilmington 99, Delaware.

INCORPORATED

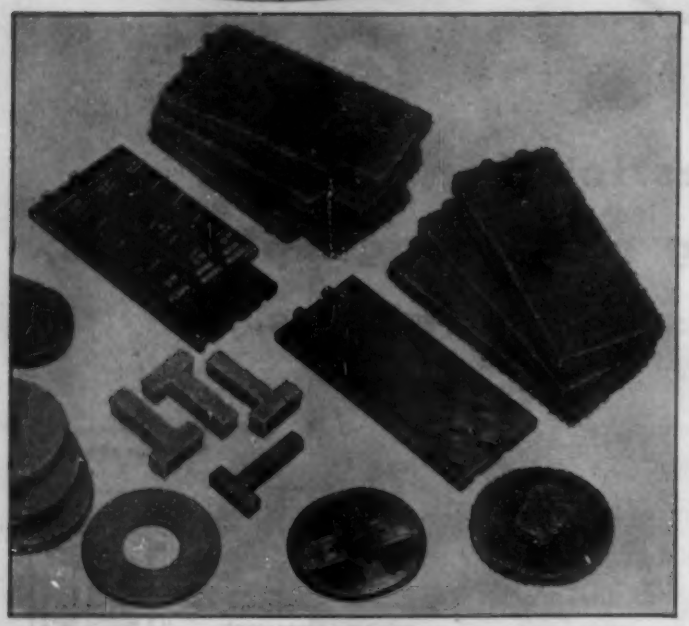
CO-RO-LITE*

The Rope Fibre Plastic

CO-RO-LITE is a ready-to-mold, high-impact, industrial plastic compound, reenforced with long, tough, interwoven rope fibres. Effective interweaving is accomplished by a patented needling operation which drives tufts of fibres through the mass, forming a uniform bulk. The fibre bulk of these bats can be controlled thereby varying the character and density of the finished plastic. This bat is impregnated with a thermo-setting powdered resin, and sintered to facilitate handling.

Die, transfer, flash, and fluid pressure molding are practicable with CO-RO-LITE, and required results are obtained with pressure varying from 80 psi in fluid pressure molding, to 3000 psi in die molding. Molding temperatures for both high and low densities range from 270 to 350 deg. F.

CO-RO-LITE offers many distinct physical advantages for tough-service applications in the field of industrial plastics. CO-RO-LITE products are hard, smooth and lustrous.



CO-RO-LITE products and the pre-forms from which they were molded. CO-RO-LITE is also supplied in sheets of standard sizes.

Write for a copy of the booklet "Columbian CO-RO-LITE Rope Fibre Plastics", it contains engineering data, illustrations, and descriptive information on molding this strong, tough plastic.

ARMY E NAVY

ALLIED PRODUCTS DIVISION

*Process patented; trademark registered in U. S. Pat. Off.

COLUMBIAN ROPE COMPANY

460-92 Genesee St., Auburn, "The Cordage City," N. Y.

Canadian Licensee, Canadian Bridge Engineering Company, Ltd.
Box 157, Walkerville, Ontario, Canada

Du Pont Formaldehyde

HIGH PURITY
UNIFORM STRENGTH
WATER-WHITE COLOR
LOW ACIDITY

DU PONT FORMALDEHYDE is produced under rigid control and supervision. The product is designed to meet the high requirements of the plastics industry.

SHIPMENTS in standard containers are made from the factory or stocks maintained in principal cities.

AVAILABILITY subject to WPB General Allocation Order M-300 Appendix. A material under Schedules 9 and 10, "Small Order Exemptions," 1,500 lbs. of 37% Formaldehyde, 500 lbs. of Paraformaldehyde and 10,000 lbs. of Hexamethylenetetramine can be obtained without application to WPB. Quantities in excess of the above require application on form WPB-2945 (PD600). Filing date is 15th of month preceding month of delivery.

* * *

Depend on Du Pont also for: PARAFORMALDEHYDE—powdered or granulated, 95% minimum strength. And HEXAMETHYLENETETRAMINE—U.S.P. crystals or technical. Call our nearest district office for information and technical assistance. Electrochemicals Department, E. I. du Pont de Nemours & Co. (Inc.), Wilmington 98, Delaware.

District Offices: Baltimore, Boston, Charlotte, Chicago, Cleveland, Kansas City,* New York, Philadelphia, San Francisco. **Barada & Page, Inc.*

DU PONT

BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

DU PONT ELECTROCHEMICALS

HARDESTY DIBUTYL SEBACATE

means

HIGHEST PLASTICIZING POWER

The main purpose of a plasticizer is to impart flexibility to plastic materials and elastomers. In this property, Hardesty Chemical Dibutyl Sebacate is one of the most efficient plasticizers known. This is strikingly shown in the following table giving the properties of test strips of Vinylite VYNW containing three different plasticizers. The basic formulation used in making these strips consisted of 100 parts of Vinylite VYNW, 55 parts of plasticizer, 2 parts of calcium stearate, and 0.75 part of stearic acid. This mixture was milled on a two-roll mill with roll temperature of 300–310°F., and then molded for ten minutes at 300°F. and chilled under pressure.

These properties show the outstanding plasticizing power of Hardesty Chemical Dibutyl Sebacate. This plasticizing power is retained at extremely low temperatures, as shown by the cold cracking tests in the table below.

Hardesty Chemical Company Dibutyl Sebacate is used as a plasticizer for the vinyl copolymers, polyvinyl chloride, polyvinyl butyral, nitrocellulose, cellulose acetobutyrate, acrylic resins and synthetic rubbers.

In addition to its high plasticizing power and low temperature flexibility, Dibutyl Sebacate is also characterized by its high solvency for various elastomers. It is extremely resistant to yellowing on long exposure to light, tasteless and has no residual odor.

A letter to Hardesty Chemical Company will bring a sample and further information by return mail.

Plasticizer	Modulus at 100% Elongation	Tensile at Break	Elongation	Set	Shore Hardness	Cold Cracking Temperature
Dibutyl Sebacate	584 p.s.i.	2220 p.s.i.	405%	50%	62	Below −80°F
Dioctyl Phthalate	1075 p.s.i.	2795 p.s.i.	365%	39%	79	−45°F.
Tricresyl Phosphate	1780 p.s.i.	3150 p.s.i.	285%	27%	85	0°F.

Properties of Dibutyl Sebacate

Purity	98.5% minimum
Specific Gravity	0.935 20/20°C.
Acidity as Sebacic	0.3% maximum
Color	Light straw
Sediment	None
Ash	0.001% maximum
Copper	None
Iron	0.3 ppm maximum
Butanol	0.1% maximum
Flash Point	380°F.
Fire Point	420°F.
Boiling Point	344°C. at 760 mm. 175–180°C. at 3 mm.
Water solubility	Less than 1% at 25°C.
Freezing Point	11°F.
Weight per gallon	7.8 lbs.
Index of Refraction	1.4391 at 25°C.
Dielectric Constant	3.6
Power Factor—60 cycles	.6

HARCHEM

PLASTICIZERS

Alkyl Roleates

Dibutyl Sebacate

Capryl Alcohol

HARDESTY CHEMICAL COMPANY, INC., 41 EAST FORTY-SECOND STREET, NEW YORK 17, N.Y.

We take our own Kick in the Pants

—if we earn it!

Maybe you know the plastic molder's best alibi when his shipments to you go astray—"metal insert trouble." Either shipments to him wandering off, or wandering tolerances after they get there—he says. Well, at Kurz-Kasch, we can't pass the buck on your plastic molding schedule! Luckily, we don't have to very often.

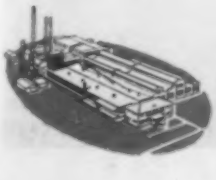
We take full responsibility for *all* inserts, most of which are made right in our plant—all kinds, of all metals, by all methods. That means that when you place your molding job with Kurz-Kasch, you're also placing complete responsibility for that job in full—that engineering, mold-making, insert-making, molding and finishing will mesh together to get out specified quantities at stated times without excuses.

All these facilities are grouped under one roof in one of the largest, best-equipped exclusive custom molding plants in the country—and our Dayton, Ohio, address makes it mighty convenient. We'll let our 28-year-old record of service to American industry speak for the caliber of our work. What *we* want to say is—if you have molded plastics on your mind, talk it over with a Kurz-Kasch engineer. No obligation—just ask.

"A Businessman's Guide to the Molding of Plastics"

Send for your free copy of this illustrated brochure. Just write to Dept. 7 on your letterhead and we'll send it with our compliments.

Kurz-Kasch



For over 28 years Planners and Molders in Plastics

Kurz-Kasch, Inc., 1415 South Broadway, Dayton 1, Ohio. *Branch Sales Offices:* New York • Chicago • Detroit Indianapolis • Los Angeles • Dallas • St. Louis • Toronto, Canada. *Export Offices:* 89 Broad Street, New York City

A New Home for PLASTICS EDUCATION

Now even finer educational facilities are available to those who seek thorough, practical plastics instruction. Plastics Industries Technical Institute has moved its Los Angeles resident engineering school to new and larger quarters on a five-acre campus. The Administration Building is shown in the picture above.

The resident school will continue to provide practical training in its shops and laboratories with equipment similar to that used by the plastics industry. You are cordially invited to visit the new campus when in Los Angeles. Meanwhile, we welcome your inquiries regarding resident plastics training and the home study course.

Plastics
INDUSTRIES TECHNICAL
INSTITUTE

Francis A. Gudger, President · John Delmonte, Technical Director

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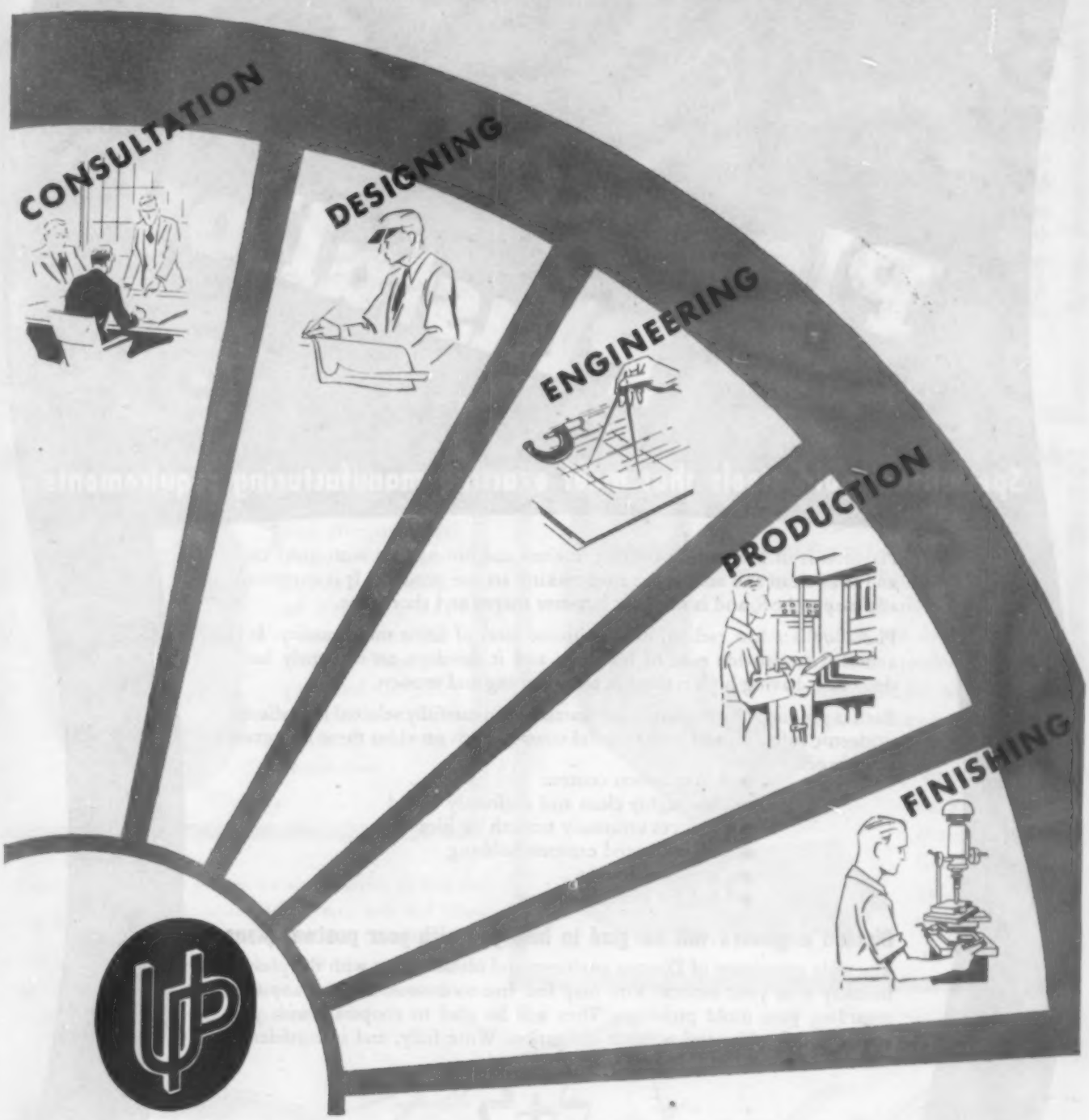
A Complete Custom Molding Service



UNIVERSAL
PLASTICS CORPORATION
NEW BRUNSWICK · NEW JERSEY

Main Office: 270 Madison Avenue, New York 16, New York • Steel Mill Products Company, Inc.: 176 West Adams Street, Chicago 3, Illinois • Paragon Sales Company, Inc.: 111 South Street, Philadelphia, Pennsylvania • June & Company: 719 New Center Building, Detroit 1, Michigan

Our plant facilities are extensive and varied, comprising every service from designing to machining and finishing. To operate such a plant requires the combined skills and experiences of many experts and technicians. At Universal, you will find a setup which is ideal for the production of custom moldings in large quantities. Every operation is under our own roof and our complete control. Whether your requirements are immediate or postwar, we invite you to consult our Planning Division.

Plastiron Plastalloy

Specialized mold steels that meet exacting manufacturing requirements

Plastiron is of low carbon content, melted and hot-worked with great care, and is as clean and soft as the steel-making art can produce. It is exceptionally easy to hob, and is ideal for intricate shapes and short runs.

Plastalloy is a low carbon, nickel chrome steel of finest mold quality. It is annealed to provide ease of hobbing, and it develops an extremely hard, deep case, having high resistance to swamping and erosion.

Each is produced by modern steel practice from carefully selected ingredients, in electric furnaces, and under careful control. Each provides these important advantages:

- A low carbon content
- Thoroughly clean and uniformly sound
- Produces unusually smooth cavities
- Will withstand extreme hobbing
- Carburizes evenly
- Ideal for difficult shapes

Disston engineers will be glad to help you with your postwar plans

The wide experience of Disston engineers and metallurgists with the plastics industry is at your service. You may feel free to consult them at any time regarding your mold problems. They will be glad to cooperate with you, advise you frankly, and without obligation. Write fully, and in confidence.

ESTABLISHED 1840

REG. U.S. PAT. OFF.

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Dempsey-Ross Steel Company
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Newark, New Jersey

HENRY DISSTON & SONS, INC., 634 Tacony, Philadelphia 35, Pa., U.S.A.

FROM PREWAR REFRIGERATOR DOOR PANEL...TO B-26 UNITS ...TO AN IMPROVED LID FOR POSTWAR HOME FREEZERS

1 Better insulation, saving in weight, greater strength, and reduction in assembly time resulted from the prewar development of the Panelyte Refrigerator Inner Door Panel.

2 Weight-saving and fast production were major requirements for the B-26 Storage Compartment Boxes. A molded section, as used in the Door Panel, with a hinged surface sheet for the door, both of Panelyte, solved the problem.

3 For compartment doors in B-26 fuselages, a surface sheet of Panelyte was cemented to the molded Panelyte part, and the unit mass-produced and delivered ready for installation.

4 Combining the principle of the molded Box section from the Storage Compartment, filling it with an insulating material, and cementing on a flat sheet, as was done with the Fuselage Door, produces a single or double lid for home freeze units and ice-cream cabinets. Sanitary, light-weight, durable, attractive and easy to keep clean, Panelyte lids are practical and economical.

PERHAPS PANELYTE CAN SERVE YOU At present, we are producing molded and fabricated parts, sheets, rods and tubes, for war uses. Our facilities may enable you to increase production or reduce costs now, or increase the saleability of your postwar products. A discussion entails no obligation. Send for factual "Data Book."

PANELYTE *the structural plastic*

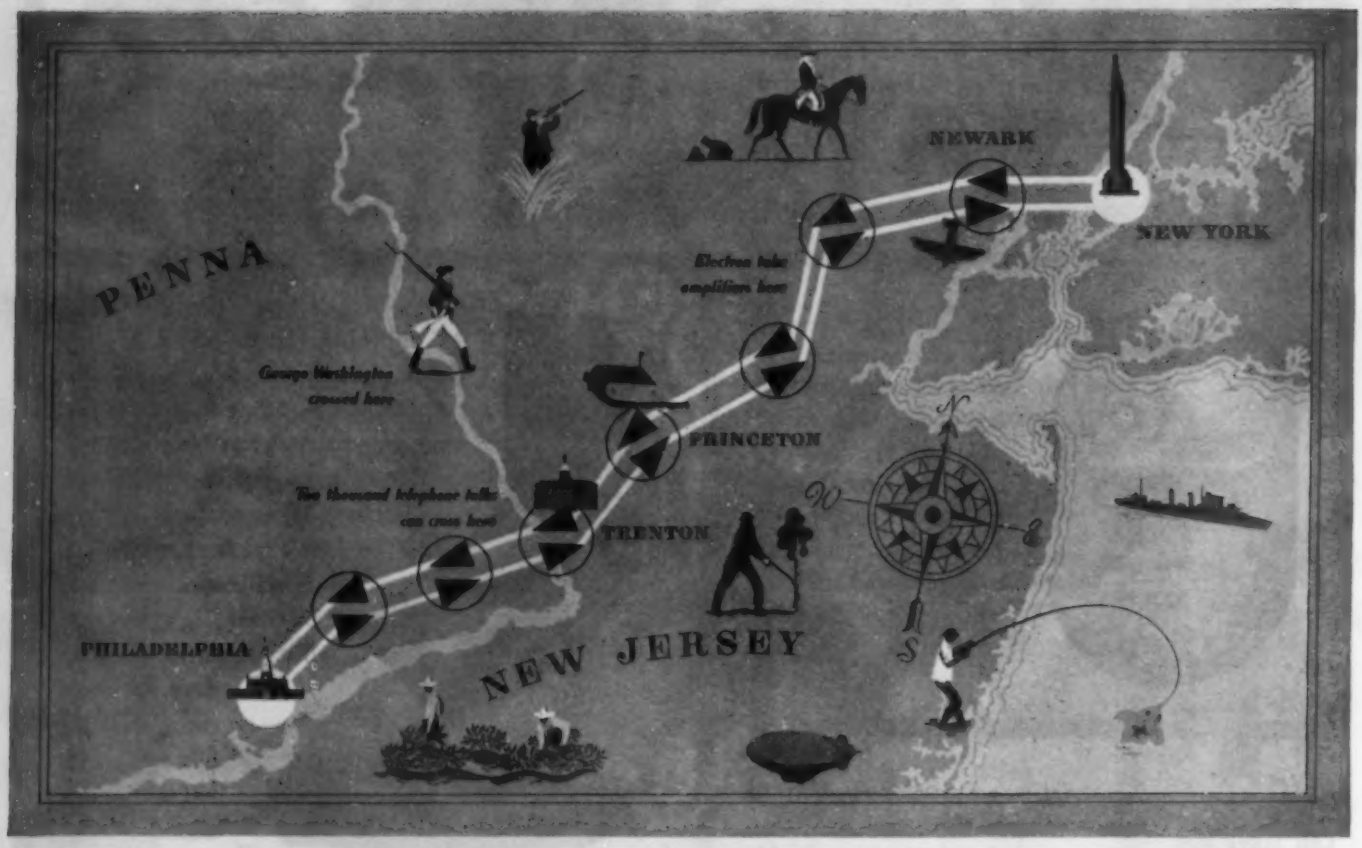
PANELYTE DIVISION
ST. REGIS PAPER COMPANY
230 PARK AVENUE
NEW YORK 17, N. Y.

Sales Offices: Atlanta, Boston, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Kansas City, Los Angeles, Mexico City, Montreal, New Orleans, Phoenix, Portland, St. Louis, St. Paul, San Francisco, Seattle, Syracuse, Toronto, Trenton, Vancouver.

★ RECORD MAKER IN DESIGN, DEVELOPMENT AND MASS PRODUCTION OF STRUCTURAL RESINOUS LAMINATED PARTS FOR THE REFRIGERATOR INDUSTRY

90-MILE LABORATORY

for Telephone and Television



BETWEEN telephone offices in New York and Philadelphia once stretched a strange sort of laboratory. Most of the way it was underground; engineers made their measurements sometimes in manholes. It was a lead-sheathed cable containing two "coaxials" – each of them a wire supported in the center of a flexible copper tube the size of a lead pencil.

Theory had convinced engineers of Bell Laboratories that a coaxial could carry many more telephone talks than a full-sized voice frequency telephone cable; that it could carry adequately a television program. Experimental lengths were tested; terminal apparatus was designed and tried out. Finally, a full-sized trial was made with a system designed for 480 conversations. It was successful; in one demonstration people talked over a 3800-mile circuit looped back and forth. Now the cable is carrying some of the wartime flood of telephone calls between these two big cities.

This cable made television history also: through it in 1940 were brought spot news pictures of a political convention in Philadelphia to be broadcast from New York. Bell System contributions to television, which began with transmission from Washington to New York in 1927, have been laid aside for war work. When peace returns, a notable expansion of coaxial circuits is planned for both telephone and television in our Bell System work.

BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting for our Armed Forces at war and for continued improvements and economies in telephone service.

VISIBILITY UNLIMITED — WITH *Plexiglas*

ON today's helicopter, aircraft engineers find another place to put strong, crystal-clear, light-weight PLEXIGLAS to work. Known for its years of service on every type of Army and Navy plane as "aviation's standard transparent plastic," PLEXIGLAS is the logical choice for the nose section of this newest development in the nation's wartime aviation progress.

On the Sikorsky R-5 pictured here, a large one-piece nose of PLEXIGLAS gives the pilot a clear and unrestricted view...facilitates rescue work and evacuation of wounded. Weight is saved in two ways: by the elimination of metal framework, and by the lightness-with-strength of PLEXIGLAS itself. By a combination of stretch and vacuum forming, R-5 noses of PLEXIGLAS are now being produced on a volume basis.

This application is one more example of the wide range of possibilities for forming large sheets of PLEXIGLAS into three-dimensional sections — possibilities having very great significance to the fabricator or buyer desiring to take advantage of the remarkable combination of properties offered by PLEXIGLAS. For technical advice or assistance, call or write our nearest office: Philadelphia, Detroit, Los Angeles, Chicago, Cleveland, New York. Canadian Distributor: Hobbs Glass Ltd., Montreal.

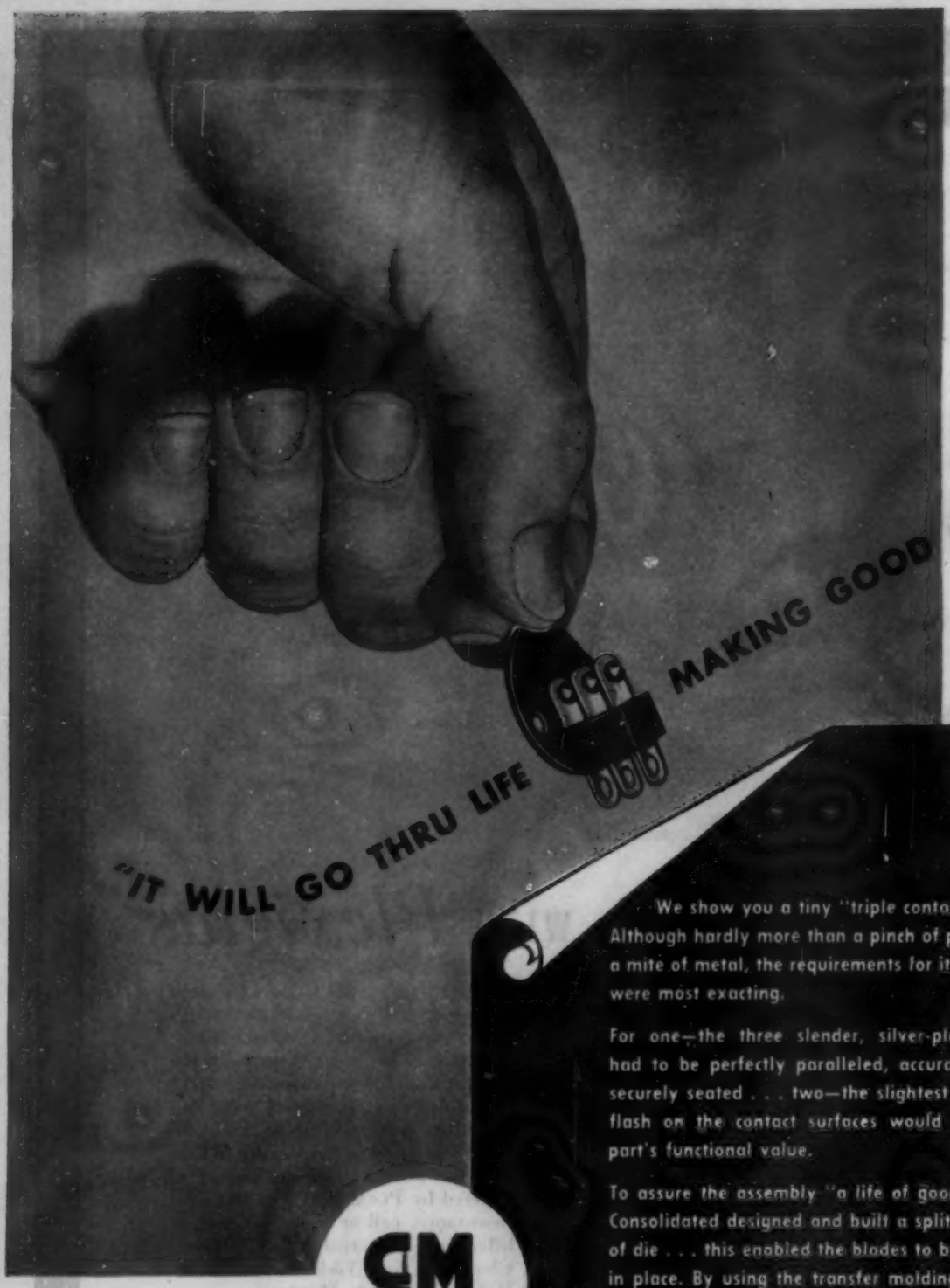
ONLY ROHM & HAAS MAKES *Plexiglas* CRYSTAL-CLEAR ACRYLIC SHEETS AND MOLDING POWDERS

PLEXIGLAS is the trade-mark, Reg. U.S. Pat. Off., for the acrylic resin thermoplastic sheets and molding powders manufactured by Rohm & Haas Company.
Represented by Cia. Rohm y Haas, S.R.L., Carlos Pellegrini 331, Buenos Aires, Argentina, and agents in principal South American cities.

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Manufacturers of Plastics — Synthetic Insecticides — Fungicides — Enzymes — Chemicals for the Leather, Textile, Enamelware, Rubber and other Industries



"IT WILL GO THRU LIFE MAKING GOOD CONTACTS"

We show you a tiny "triple contact part" . . . Although hardly more than a pinch of phenolic and a mite of metal, the requirements for its production were most exacting.

For one—the three slender, silver-plated blades had to be perfectly paralleled, accurately alined, securely seated . . . two—the slightest presence of flash on the contact surfaces would destroy the part's functional value.

To assure the assembly "a life of good contacts," Consolidated designed and built a split cavity type of die . . . this enabled the blades to be positioned in place. By using the transfer molding technique, distortion possibilities were completely eliminated . . . and each unit, when removed from the mold, was free of flash—"as clean as a whistle."

Consolidated's molding know-how deserves your consideration. Inquiries invited!

CMP

"YOUR BLUEPRINT IN PLASTIC"

COMPRESSION MOLDING
TRANSFER MOLDING
INJECTION MOLDING

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MOLDED PRODUCTS *Corporation*
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Now in plant production

STYRAMIC HT

the new thermoplastic electronic engineers required

Heavy in the scales of Victory, but light and efficient as an insulating material for air-borne electronic equipment . . . that's Styramic HT!

Now in plant production, Styramic HT was developed by Monsanto plastics research specifically to meet the need for a moldable plastic with peak insulating efficiency at super high frequencies *plus* high enough heat resistance to stand up under temperatures generated in electronic equipment.

Styramic HT meets the need . . . with the *best electrical properties ever attained by a rigid plastic,* and with an *ASTM heat distortion point of 236°F.* As a result, many insulating parts can now be designed for maximum savings in precious weight and bulk.

In addition to these record breaking properties, Styramic HT offers other qualities important to the electronic engineer . . . making a combination entirely unique in the Plastics industry:

- low water absorption
- excellent dimensional stability
- "self-extinguishing" (by ASTM tests for inflammability)
- high heat-resistance without sacrifice of moldability; may be extruded or injected in standard machines
- durability: exceptionally hard surface with Rockwell Hardness value of M103, excellent chemical resistance, and good mechanical strength
- good color range, starting with clear, light yellow transparent

Styramic HT is being produced today for high priority end uses only, in a plant just completed by the DPC and designed and operated by Monsanto's Plastics Division at Springfield, Mass.

For more information on Styramic HT for war or postwar applications, address: MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield, Massachusetts.

CHECK LIST OF STYRAMIC FACTS

Moldability in injection molds	good*
Injection molding temperatures, °F.	475–550
Compression molding temperatures, °F.	360–400
Machining qualities	good
Specific gravity	1.38
Water absorption, 24 hr., percent	0.03
Flammability, in./min.	self-extinguishing
Heat distortion point, °F.	236
Rockwell hardness	M103
Dielectric constant, 1000 cycles	2.62
Power factor, 1000 cycles	0.0002
Dielectric constant, 1000 cycles	2.62
Power factor, 1,000,000 cycles	0.0002

*Moldability in extrusion machines is excellent.

The broad and versatile Family of Monsanto Plastics includes: Lustron polystyrenes • Cerex heat resistant thermoplastics • Vinyl acetals Nitron cellulose nitrates • Fibestos cellulose acetates • Resinox phenolics • Thalid for impression molding • Resimene melamines. Forms in which they are supplied include: Sheets • Rods • Tubes Molding Compounds • Industrial Resins • Coating Compounds Vuepak rigid, transparent packaging materials.

MONSANTO PLASTICS

SERVING INDUSTRY, WHICH SERVES MANKIND

OUT GOES SPOILAGE!

Hamstrung by work-spoiling driver skids while he used slotted screws, a certain radio cabinet manufacturer made a complete switch-over to Phillips Recessed Head Screws. Result: production shot up like a rocket!

DOWN GO COSTS!

With this upward swing in production, there was a consequent *downward* swing in costs. A downswing that was helped along plenty by the fact that Phillips Screws drive up to 50 percent faster!

UP GOES STRENGTH!

On production . . . on costs . . . yes, also on design, . . . use of Phillips Screws makes a big difference. Engineered for heaviest driving pressures, they help designers plan exceptional strength and rigidity into products!

AWAY GOES SALES RESISTANCE!

Saleswise, too, use of Phillips Screws pays off. They not only add to a product's strength, smartness, and general good looks. They also banish burrs that snag clothes and sidetrack sales!

It's Phillips — the engineered recess!

In the Phillips Recess, mechanical principles are so correctly applied that every angle, plane, and dimension contributes fully to screw-driving efficiency.

. . . It's the exact pitch of the angles that eliminates driver skids.

. . . It's the engineered design of the 16 planes that makes it easy to apply full turning power – without reaming.

. . . It's the "just-right" depth of recess that enables Phillips Screw Heads to take heaviest driving pressures.

With such precise engineering, is it any wonder that Phillips Screws speed driving as much as 50% – cut costs correspondingly?

To give workers a chance to do their best, give them faster, easier-driving Phillips Recessed Head Screws. Plan Phillips Screws into your product now.

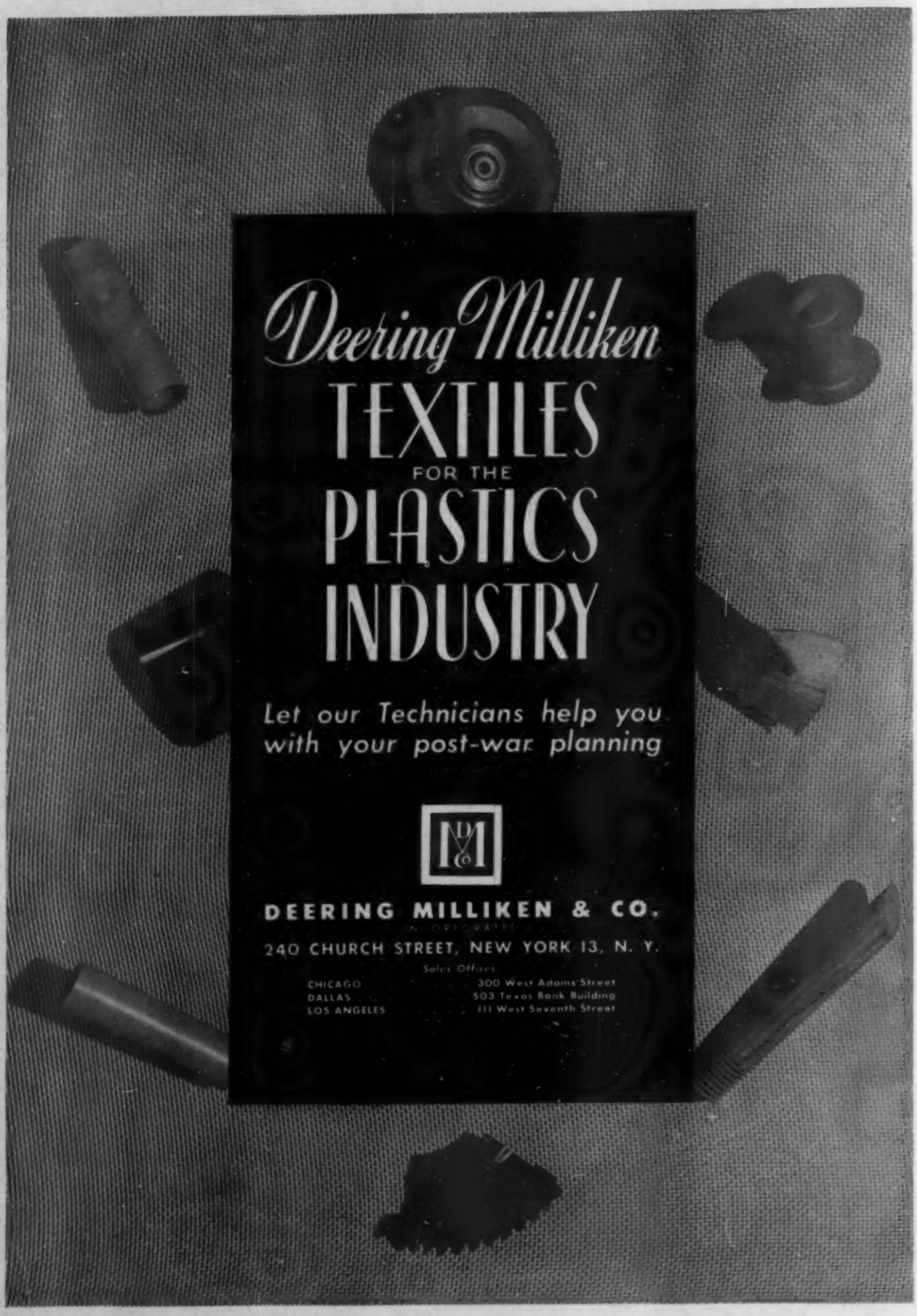
PHILLIPS *Recessed Head* SCREWS

WOOD SCREWS • MACHINE SCREWS • SELF-TAPPING SCREWS • STOVE BOLTS

Made in all sizes, types and head styles

25 SOURCES

American Screw Co., Providence, R. I.
Atlantic Screw Works, Hartford, Conn.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
General Screw Mfg. Co., Chicago, Ill.
The H. M. Harper Co., Chicago, Ill.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
Manufacturers Screw Products, Chicago, Ill.
Milford Rivet and Machine Co., Milford, Conn.
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
The Steel Company of Canada Ltd., Hamilton, Canada
Wolverine Bolt Co., Detroit, Mich.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Let our Technicians help you with your post-war planning
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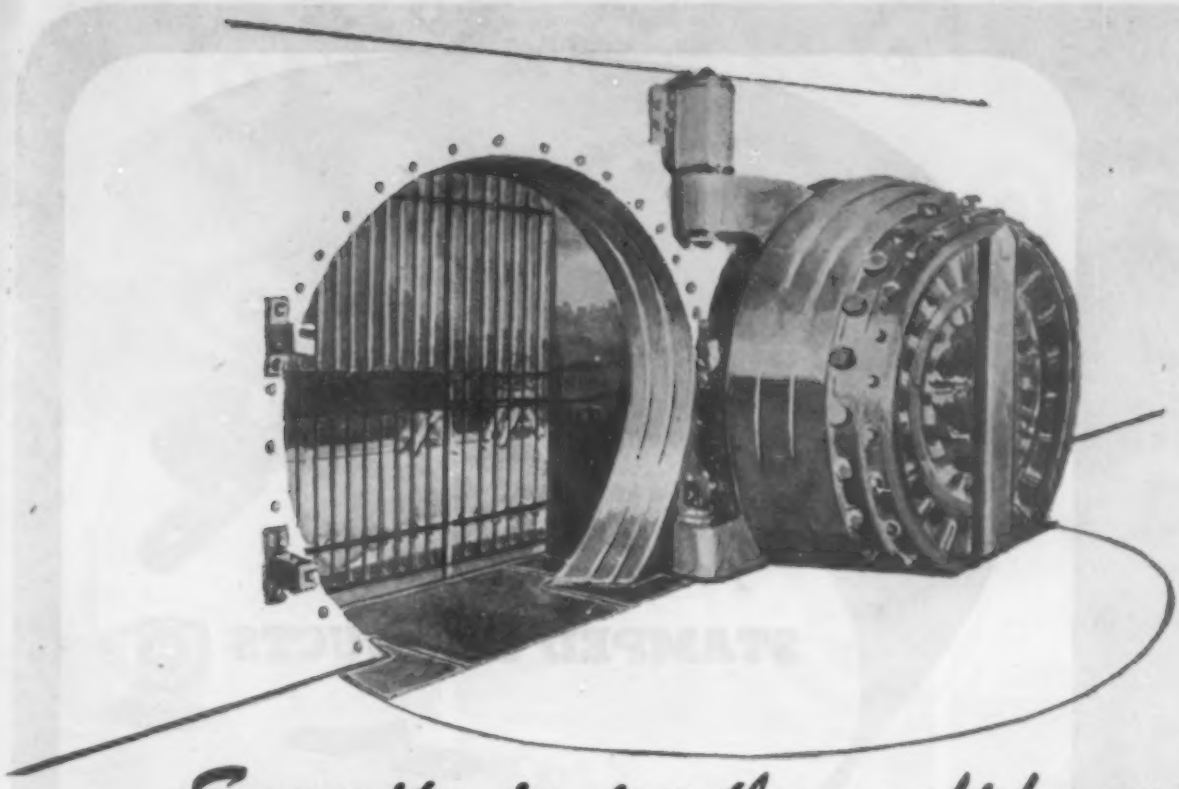

Security is partly confidence

Plastics coat hook capable of supporting 280-pound weight. Molded by Pyro.

This plastics scoop replaced heavier metal type. Injection molded by Pyro.

Behind the bolts and bars of a safe deposit vault is your confidence in the bank itself, in the integrity and experience of its personnel.

In selecting a custom molder, you feel secure when you know that they have the experience and facilities to handle your work and can be trusted with the development of your ideas. At Pyro, we are repeatedly entrusted with the design and development of new products. We welcome inquiries from manufacturers with new ideas.

For fine workmanship specify **Pyro** *molded plastics*

THE PYRO PLASTICS COMPANY · WESTFIELD · NEW JERSEY


Flat Strips for
STAMPED PRODUCTS
Yardley is equipped to extrude any kind and color of thermoplastic material in continuous lengths up to 6" in width. Tolerances and thicknesses are carefully controlled to your specifications from .015 to .125.
Continuous strips we now make for stamped products include:
SARAN ETHOCEL STYRALLOY
ACETATE VINYL POLYSTYRENE

The Standard Products Co., Port Clinton, Ohio Plant

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The Standard Products Co., Plastics Division, St. Clair, Mich.

One of the largest injector presses in the world. Plastics Division, St. Clair, Mich.

At your service

THE STANDARD PRODUCTS COMPANY is an organization of engineers and technicians *dedicated* to the designing and manufacturing of Steechan glass-run window channel, mechanical rubber goods, metal stampings, thermo plastics, thermo setting plastics, armament, munitions and automobile hardware.

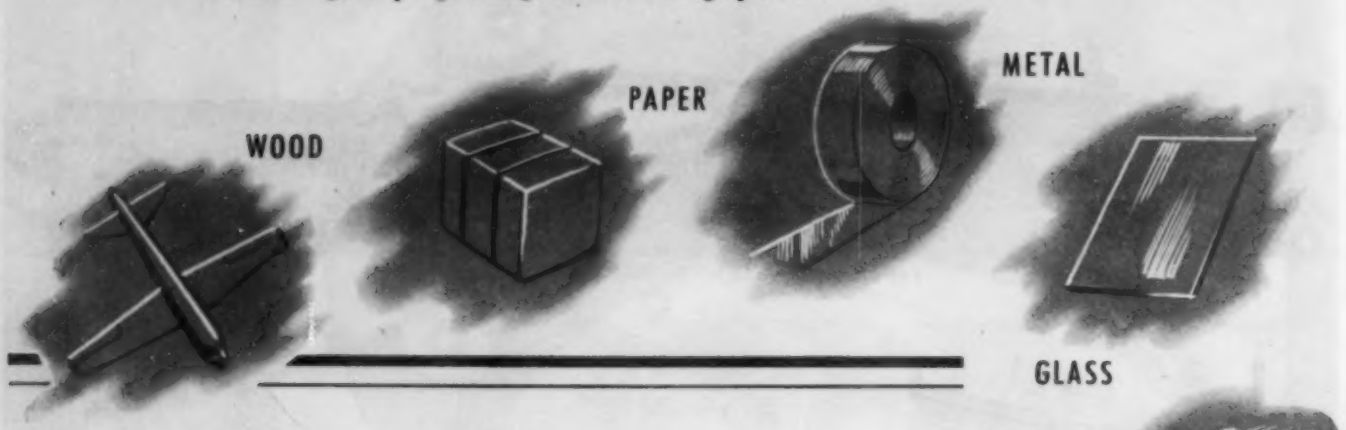
Through years of experience, this company has acquired a wealth of knowledge in the art of creative development and production. Standard Products reputation for *efficiency* in manufacturing did not just happen, but is the result of a slow, careful building process, developed by a corps of top-flight executives, engineers and loyal workers . . . definite personalities that are reflected in the products they produce.

★ ★ ★

The Standard Products' engineering and planning divisions are at your service. Mail all inquiries to The Standard Products Company, 505 Boulevard Bldg., East Grand Blvd. at Woodward, Detroit 2, Mich.

THE STANDARD PRODUCTS COMPANY

INTERLAKE Production-Stabilized Resins have been developed to precise requirements of many specific applications in coating, impregnating, and bonding of . . .



Let us work with you to PRECISIONIZE a Resin for *your* job!

DEVELOPING, adjusting and production-stabilizing a resin for a specific application—to obtain *and maintain* exact, desired resin properties—is a chemical operation requiring high technical knowledge—not only of resins—but *of the conditions and requirements of the specific application.*

That's why Interlake—while developing a specification resin—works *with your production men, in your plant,* to test and perfect that resin in actual application under normal conditions of use.

That's why Interlake is known for *functionally engineering* resins to specific jobs—as it is also known to stabilize them for *continuous uniformity in performance.*

If you have a resin problem, draw freely upon the wide experience of Interlake. We will gladly work with you on any resin problem, or discuss with you the possible advantage of using resins in any operation or process. Write Interlake Chemical Corporation, Plastics Division, Dept. 15, Union Commerce Bldg., Cleveland 14, Ohio.

INTERLAKE CHEMICAL
Corporation
PLASTICS DIVISION

Specificity IN RESINS

For Appearance Sake

Aluminum and Plastics make a Striking Pair

This door of the Gale Evaporator is made of aluminum with blue plastic decorative trim.

This Temperature Regulator Panel is aluminum with Alumilite* finish against enamel background; center insert is transparent plastic.

*Registered trade mark

There's cause for admiration when Aluminum and Plastics appear together. They make an attractive couple.

Plastics, with its colorful adaptability, and Aluminum, with its light weight and strength, make the ideal combination to bring new beauty to a product.

There are many ways in which a combination of these materials can add new beauty to your products, too. Alcoa engineers will be glad to help you find the best way to combine them. Write ALUMINUM COMPANY OF AMERICA, 2175 Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA FIRST IN **ALUMINUM**

ALCOA ALUMINUM

Hawley..THE WORLD OVER...PIONEERS IN PLASTICS, SOLVING TODAY...TOMORROW'S PROBLEMS

Hawley's Global facilities, long established with the reputation of definite leadership in the Plastic field, are the result of years of proven and successful experience in the growth and transition of the Plastic World. With plants in the new and old Worlds—the constant exchange of Ideas and latest developments—the solving of interrelated problems with their ever-changing and newly discovered applications, and the consequent results of the swift and steady growth of the Hawley organization account for Hawley as being the recognized authority in Resin Fibre and molded Fibre Products.

We at Hawley are proud of our Accomplishments to date. For many years the development of better Plastics has been a tradition with us, and Tomorrow's developments are always a challenge "for the best that is yet to come."

ANOTHER HAWLEY FIRST...HAWLEY-MADE AIR HOSTE AYS A

Model of world's largest Transport Plane, giant Consolidated Vultee, of which Pan-American World Airways has ordered a fleet. Each plane will carry 204 passengers, 15,300 pounds of baggage, mail and express—will be 12 times size of standard twin-engined commercial aircraft—wing span equal to height of 21-story building. Flying time New York to London 9 hours. Six engines will produce power equivalent to 353 automobiles.

SYDNEY, AUSTRALIA...ST. CHARLES, ILLINOIS, U.S.A....BRANTFORD, CANADA...LONDON, ENGLAND...BUENOS AIRES, S. AMERICA

GLOBALLY ESTABLISHED, THE HAWLEY PLANTS ASSURE WORLD-WIDE LEADERSHIP IN THE PLASTIC FUTURE OF TOMORROW'S WORLD

NO HAWLEY PLANT IN THE FOUR CORNERS OF THE EARTH IS MORE THAN 60 HOURS FLYING TIME FROM THE HOME PLANTS IN THE UNITED STATES

OSTE AYS ARE NOW BEING USED BY THE GLOBAL PAN-AMERICAN AIRWAYS SYSTEM, AS WELL AS ALL OTHER MAJOR AIRLINES IN THE AMERICAS

Today our facilities are concentrated on the needs of the Armed Forces, and the manufacture of plastics for war equipment for the Aviation, Radio, Automotive, Electrical appliance, Housing, and other specialized fields . . . Plastics ranging from one-half inch diaphragms that are a vital part of communications equipment, to explosive containers that share a vital part in the winning of the war.

When the day of Victory arrives, and we are again free to use fully our resources and enterprises in a peaceful world, Hawley Resin Fibre Plastics will enter upon a new Era of further successful developments in the coming Plastic World.

LICENSING MANUFACTURERS

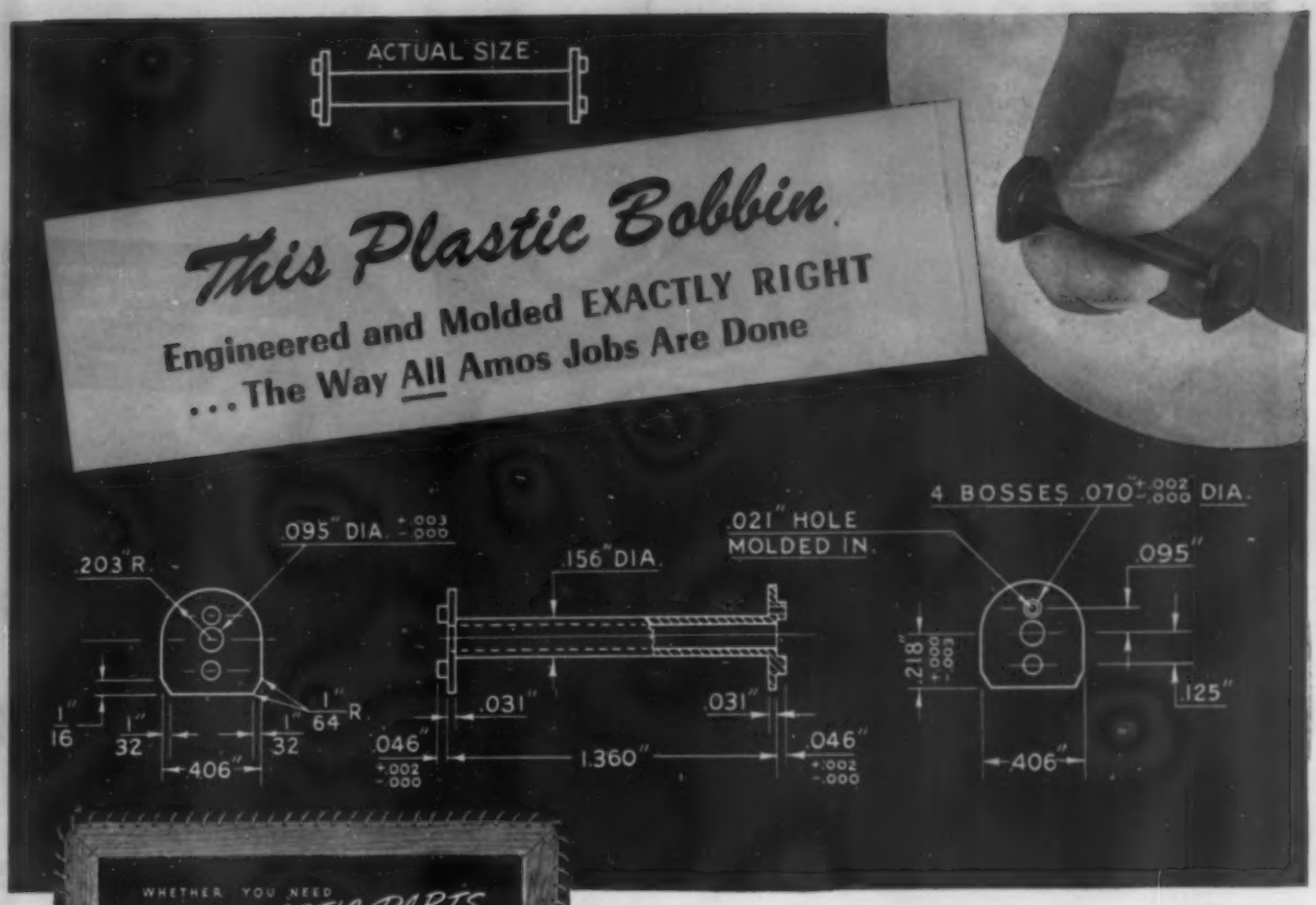
MOULDED FIBRE PRODUCTS

Hawley

RESIN FIBRE PLASTICS

ST. CHARLES, ILLINOIS

PRODUCTS COMPANY



It wasn't easy to engineer and mold this tiny plastic bobbin for an electrical coil, with its .021" fine-wire-hole molded in one of the four bosses—and all the other important details you see above. It was a precision job. And it was done exactly right—like all Amos jobs.

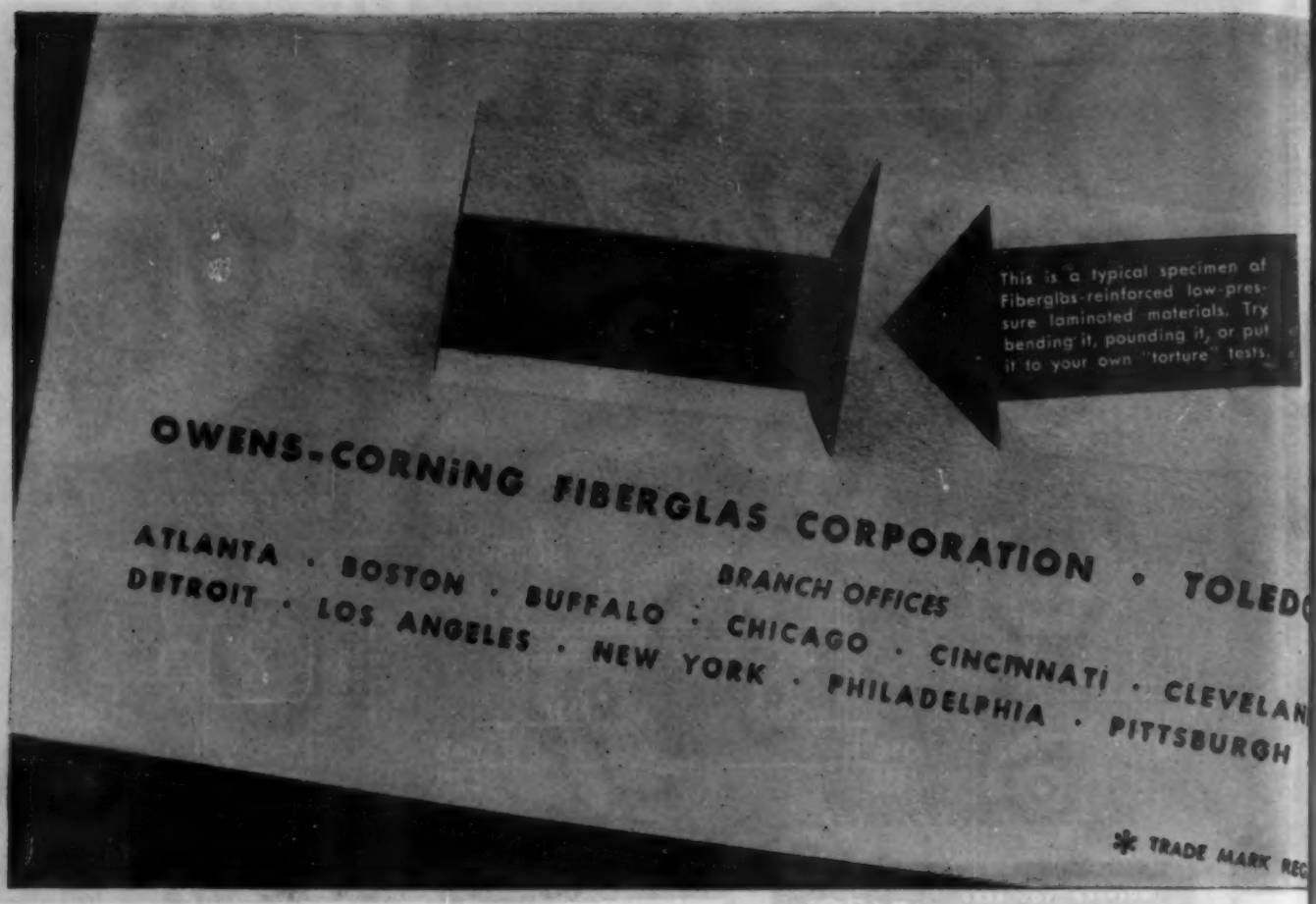
From engineering to finishing, Amos does plastic molding jobs that go into many different fields. Whether it be a large or small component part for some machine or appliance—or an all-plastic product—Amos does the job completely—*and does it right*—the way the customer wants it.

Amos facilities are being greatly expanded. A new plant has been completed and equipped to take care of more customers who want their post-war plastic molding jobs done right. Now's the time to get your jobs ready for fast production when materials are available. Just send us your drawings or write us what you have in mind to be molded in plastics.

AMOS MOLDED PLASTICS • EDINBURGH, INDIANA
Division of Amos-Thompson Corporation

Amos
MOLDED PLASTICS...

CUSTOM *Molders of*
Plastic Parts and Products
INJECTION • COMPRESSION



WANT TO TEST IT YOURSELF?

FIBERGLAS*-REINFORCED plastics have passed the "aircraft test" with flying colors. This new material is being used in the fabrication of flat sheets, structural members and formed parts in many types of aircraft where great strength with light weight, dimensional stability, and resistance to moisture and temperature changes are of vital importance. It combines properties and characteristics which are not found in other materials.

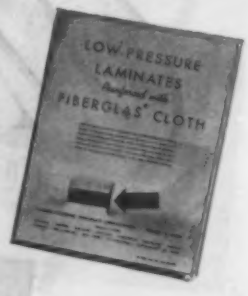
Test it yourself. Write for the sample laminate included with the new folder "Low-Pressure Laminates Reinforced with Fiberglas Cloth". Try bending it, pounding it, or put it to your own torture test. Then determine where the advantages of this improved material can be applied to the products you are planning on making.

Fiberglas is glass in the form of fine fibers or filaments having extremely high tensile strength. Twisted into yarns, woven into cloths and tapes, these Fiberglas textiles impart their properties to the finished low-pressure plastics laminates.

For example, impact strength from five to ten times that previously obtained in laminates is now being attained through Fiberglas reinforcement. The glass fibers have great flexibility and stand high stresses without permanent deformation. They are not affected by moisture and temperature changes within the range of commercial usage; they remain dimensionally stable.

Write for your copy of the new folder, with sample attached, today. Owens-Corning Fiberglas Corporation, does not manufacture resins or finished laminates but will be glad to furnish experimental samples of Fiberglas textile materials and data on technique in their use with plastics. Write *Owens-Corning Fiberglas Corporation, 1876 Nicholas Bldg., Toledo 1, O.*

In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.



ARMY E NAVY

FIBERGLAS.. A BASIC MATERIAL

*T. M. Reg. U. S. Pat. Off.

The Old Country Store

The old country store-keeper prided himself on the variety of his stock. Merchandise came in fixed sizes . . . nothing made to order. We pride ourselves on the fact that we make everything to meet your specific requirements.

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C/N CELLULOSE NITRATE
C/A CELLULOSE ACETATE
E/C ETHYL CELLULOSE

Delivering TULOX to Tokyo . . .

REG. U. S. PAT. OFF.

Official U. S. Navy photo of a rocket-firing LCI smothering the beach defenses of another Jap-held Pacific isle.

May these deadly projectiles soon fall on the last-ditch defenses of Tokyo, itself!

TULOX extruded plastic tubing is an essential in certain phases of the Rocket Program . . . just as versatile TULOX tubing fills many essential needs of our fighting forces on land, on sea and in the air.

Proven in war, TULOX is already an important factor in the plans of postwar industry.

A quality product made to fine tolerance, TULOX TT tubing is available for war end-use in a full range of sizes from ⅛" O.D. to 2" O.D. for immediate delivery from warehouse stock.

We have prepared a data sheet and photo-folder of TULOX end-uses. May we send you one?

Extruded Plastics, Inc.

NEW CANAAN AVENUE, NORWALK, CONNECTICUT, U.S.A.

IN CANADA: DUPLATE CANADA, LTD., PLASTIC DIVISION, OSHAWA, ONTARIO

HERE'S LIGHT WEIGHT AND STABILITY...

FOR many mechanical and structural uses, Formica is the chosen material because of its light weight, strength, and a remarkable ability to remain unchanged under a variety of conditions.

Moisture absorption is low, and that contributes to great dimensional stability under varied conditions of humidity. The coefficient of thermal expansion is also very much lower than that of metals and that also tends to hold the original dimensions. The material possesses a high degree of chemical inertness which prevents corrosion and maintains the surface finish under a wide range of conditions.

In wearing parts the material has a tendency to wear smoothly without accumulating a corrugated surface, and that contributes to long life.

Formica engineers have a wealth of information in detail regarding these qualities which they would be glad to pass on to those interested.

FORMICA

THE FORMICA INSULATION CO., 4673 SPRING GROVE AVE., CINCINNATI 32, O.

Which one will BEST meet your requirements

Here is a group of Birdsboro compression molding presses and multiple platen sheet presses which offer a range of engineering designs to meet many plastic press requirements. Their ability to pass the toughest performance tests with ease, is being proven daily in plants from coast to coast. Operation under actual plant conditions testifies to the minimum maintenance standards set by Birdsboro Plastic Presses. Perhaps you'll find the answer to your press problem right here. In any event, when you have a press problem, call Birdsboro.

BUY WAR BONDS

BIRDSBORO STEEL FOUNDRY & MACHINE CO., BIRDSBORO, PA.

BIRDSBORO

HYDRAULIC PLASTIC PRESSES

THAT POSTWAR PLASTICS

Boom is a big word. It can mean a tremendous expansion. It can also mean a loud noise of something blowing up right in your face.

We see that a lot of industries are planning to use plastics—more are planning to use plastics than any other new material. This means, we have no doubt, that the tremendous flood of new developments will cover a lot of pitfalls into which the unwary or unwarned may stumble.

Now we have made our share of mistakes in plastics, let there be no doubt of it. But we have learned from them, as well as from our modest successes. And, as a molder of all plastics, we stand ready to pass our information on to our customers wherever and whenever they can use it.

It is one of our most important functions—that we give proper advice to our customers. We try to help them select the right material and mold it in the proper form and in the requisite numbers. We are *custom* molders and our customers' fortunes are, in a very real sense, our own.

We will be glad to offer you what help we can in your plastics production.

If you would like a little basic information about plastics so that you may understand what is going on a little better, write us on your letterhead for a free copy of "A Ready Reference For Plastics."

BOONTON MOLDING COMPANY

MOLDERS OF PLASTICS · PHENOLICS · UREAS · THERMO PLASTICS

BOONTON · NEW JERSEY · Tel. Boonton 8-2020

NEW YORK OFFICE

Chanin Bldg. 122 East 42nd Street, New York 17, N. Y., MUrray Hill 6-8540

MOLD AUTOMATICALLY

A STOKES PRESS FOR EVERY NEED

Completely Automatic Molding — on Stokes Presses — is the acknowledged, *most economical* method for producing thousands of different plastics parts.

Automatic Molding saves molding labor . . . one man operates a battery of presses. It saves time and material . . . cycles are greatly reduced through split-second timing and flash losses reduced 8% to 10% or more.

Mold cost is low because a few cavities are used to do the work of many. Product changes can be made quickly and economically because molds can be made in a fraction of the usual time and at minimum cost.

Output is high . . . up to 10,000 or more moldings per week per cavity. Parts are produced as needed, reducing excessive inventories. Parts are of highest quality . . . there are no human errors to contend with.

For your present or post-war parts, consider the advantages of Automatic Molding with Stokes Presses. Write for full information now.

F. J. STOKES MACHINE CO. 5934 Tabor Rd. Phila. 20, Pa.

STOKES 15-TON COMPLETELY AUTOMATIC MOLDING MACHINE — the machine that established Automatic Molding as sound, economical practice. Hundreds are in service making thousands of different molded pieces. Complete, self-contained unit, electrically powered and heated.

STOKES 50-TON HYDRAULIC COMPLETELY AUTOMATIC MOLDING MACHINE for larger pieces and more pieces. Features same patented controls as the 15-ton press—Automatic Cycle Controller, and Super-Sensitive Trap that checks every piece made and literally "runs the press" . . . the only proved and foolproof method of operating a Completely Automatic machine. Only 2 hp. motor required to develop full 50 tons press capacity. High-speed operation with controlled closing speed.

50th year of Service to Industry

F.J.Stokes MOLDING EQUIPMENT

FJS Est. 1895

PLASTICS HELPS ANTI-AIRCRAFT OBSERVERS

LOOK THE SUN IN THE EYE

Glasser "Filtrol" polarized variable filter attachments are now supplied to all branches of the armed forces of the United States and the British Commonwealth by the manufacturers, Beck-Lee Corporation, Chicago, Ill. Plastic parts are made by Molded Products Co.

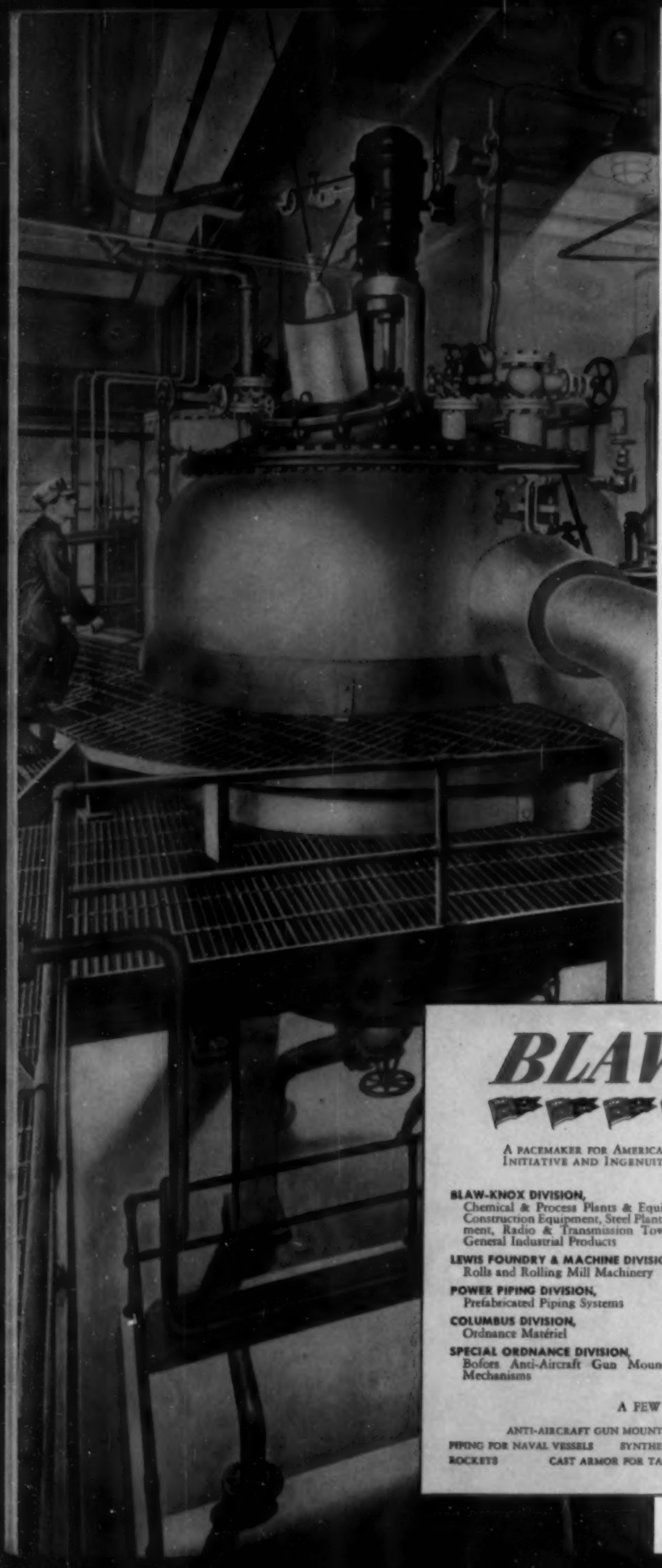
A favorite tactic of enemy airmen is to "get in the sun" where our defending gun crews are helplessly blinded. This maneuver has been spoiled for the enemy . . . and countless American lives saved . . . by an ingenious "light-valve" attachment for observers' binoculars. Instantaneously adjustable to every degree of brightness, the "Filtrol" enables observers to follow enemy aircraft into and out of the sun . . . for deadly accurate defensive fire.

The threaded eye-pieces and a number of internal functional members are plastic-molded. These pieces had to be light, strong, dimensionally stable in all climates and produced in quantity to unbelievably close tolerances. MOLDED PRODUCTS accepted this difficult assignment . . . and "delivered the goods."

Whether your problem is similarly out-of-the-ordinary or run-of-the-mill . . . ask our engineers to consult with you. MOLDED PRODUCTS COMPANY, 4533 W. Harrison St., Chicago 24, Ill.

PLASTICS DIVISION

MOLDED PRODUCTS



FIRST of its kind

SHOWN HERE is the first Dowtherm heated and cooled synthetic resin production kettle in this country. It exemplifies the chemical, engineering and fabricating "know-how" which Blaw-Knox offers to the chemical and process industries.

The leadership of Blaw-Knox has long been acknowledged in the design and production of rolls, rolling mill machinery and high temperature furnace equipment for the ferrous and non-ferrous industries. Also in numerous products emphasizing stability, efficiency and economy for railroads, electronics, public utilities, equipment for the construction industry and for industry in general, including prefabricated power piping and a host of other important products. A brief glance at the list of Blaw-Knox divisions will give you an idea of the engineering background, as well as the skills and facilities which Blaw-Knox can bring to an industrial problem within its scope.

BLAW-KNOX COMPANY

A PACEMAKER FOR AMERICAN INITIATIVE AND INGENUITY

FARMERS BANK BLDG.
PITTSBURGH, PA.

BLAW-KNOX DIVISION,
Chemical & Process Plants & Equipment, Construction Equipment, Steel Plant Equipment, Radio & Transmission Towers . . . General Industrial Products

LEWIS FOUNDRY & MACHINE DIVISION,
Rolls and Rolling Mill Machinery

POWER PIPING DIVISION,
Prefabricated Piping Systems

COLUMBUS DIVISION,
Ordnance Matériel

SPECIAL ORDNANCE DIVISION,
Bofors Anti-Aircraft Gun Mounts and Mechanisms

PITTSBURGH ROLLS DIVISION,
Rolls for Steel and Non-Ferrous Rolling Mills

UNION STEEL CASTINGS DIVISION,
Steel and Alloy Castings

NATIONAL ALLOY STEEL DIVISION,
Heat and Corrosion-Resistant Alloy Castings

MARTINS FERRY DIVISION,
Bofors Anti-Aircraft Gun Mounts

BLAW-KNOX SPRINKLER DIVISION,
Automatic Sprinklers and Deluge Systems

A FEW VICTORY PRODUCTS

ANTI-AIRCRAFT GUN MOUNTS · LANDING BARGES · POWDER PLANTS
PIPING FOR NAVAL VESSELS · SYNTHETIC RUBBER PLANTS · GUN SLIDES · 16" PROJECTILES
ROCKETS · CAST ARMOR FOR TANKS & NAVAL CONSTRUCTION · CHEMICAL PLANTS

← *Designed and built in 1937 for Devoe and Raynolds Company, Inc.*

Presenting— the most modern COMPRESSION TRANSFER MOLDING PRESSES

For Transfer Molding Operations — Use Top Cylinder

W-S BUILDS COMPLETE LINE

of Molding Equipment

- Vertical Injection Presses
- Horizontal Injection Presses
- Compression Molding Presses
- Angle Molding Presses
- Laboratory Presses
- Hobbing & Die Sinking Presses
- Heating & Chilling Presses
- Record Presses
- High Pressure Pumps
- Accumulator Systems

HIGH SPEED—Saves time on die clamping ... important when using heat in compression or transfer.

SELF-CONTAINED—Oil reservoir, pump and motor located in base ... sealed to protect against dust or dirt, but easily accessible for maintenance ... no outside piping.

AUTOMATIC CYCLE CONTROL—Push-button control of all operations eliminates manual labor ... gives controlled production and uniform cures.

DUAL PURPOSE—Easily adapted to transfer method of molding by addition of top cylinder ... efficient and economical transfer of thermo-setting materials using more economical dies, producing improved moldings at greater speed.

QUIET OPERATION—Radial, variable-displacement pump and most moving parts are enclosed—quiet operation even at highest speeds.

SIZES—These presses are available in nine sizes from 50 to 1200 tons capacity ... presses of 500-ton capacity, and upward, are equipped with an auxiliary gear pump that permits low and high pressure speeds.

DE-GASSING—This important operation controlled by timer, instead of limit switch. Speeds production by reducing set-up time.

PUSH-BUTTON CONTROL—All operations set in motion, or stopped, by push buttons ... mechanical-hydraulic knockouts returned by push button ... large palm-button assures safety of operator.

WATSON-STILLMAN

HYDRAULIC MACHINERY DIVISION

FACTORY AND MAIN OFFICE
ROSELLE, NEW JERSEY

BRANCH OFFICES

WASHINGTON, D. C.
PHILADELPHIA, PA.
NEW HAVEN, CONN.
CHICAGO, ILL.

REPRESENTATIVES

WASHINGTON, D. C. . . . . Ralph Payne (R. R. Equip.)	PITTSBURGH, PA. . . . . Laird and Johnson
INDIANAPOLIS, IND. . . . W. K. Millholland Machinery Co.	CLEVELAND, OHIO . . The Cleveland Duplex Machinery Co.
CHICAGO, ILL. . . . . E. L. Essley Machinery Co.	DETROIT, MICH. . . . . Peninsular Machinery Co.
MILWAUKEE, WISC. . . . . E. L. Essley Machinery Co.	GRAND RAPIDS, MICH. . . . . E. L. Essley Machinery Co.
ST. PAUL, MINN. . . . . Anderson Machine Tool Co.	LOS ANGELES, CAL. . . . . Smith Booth Usher Co.
SAN FRANCISCO, CAL. . . . . Jenison Machinery Co.	SEATTLE, WASH. . . . . Star Machinery Co.

CANADA: Canadian Fairbanks-Morse Co., Ltd. • Branches in All Principal Cities

7074

Better Wrappings—thanks to C. P. glycerine. Because it is non-toxic, it is safe to use in making transparent wrappings that come in contact with foods, such as cakes, candies, breads, etc.

Better Foods—thanks to glycerine. C. P. glycerine, a product of nature, is a food itself. That's why it's so beneficial and safe to use in beverages, candies, flavorings, other food products.

Better Paints—thanks to glycerine, an important ingredient in the manufacture of alkyd resins, used for making tough, long-lasting protective coatings. Nothing takes the place of glycerine.

Why Glycerine is a Superior Humectant: LOW VAPOR PRESSURE

MANY materials and products are required to remain soft and pliable—not dry out through loss of moisture. Tobacco, adhesives, and dentifrices are just a few examples of this. Humectants (hygroscopic, water-attracting agents) are used to retain and preserve these qualities, by holding moisture, and also to add their own plasticizing action.

One of the most important properties needed in a humectant is resistance to evaporation—low vapor pressure. That is an outstanding characteristic of glycerine, which, together with its other properties, is the reason why glycerine is such a superior humectant, and why it is used by so many manufacturers.

The following table shows the vapor pressures (in millimeters of mercury) of glycerine and some other humectants at 30°C.

Glycerine	*Humectant "A"*	*Humectant "B"*	*Humectant "C"*
0.0005	0.16	0.009	0.32

This low vapor pressure of glycerine means that it will "stay put." It means that the composition of the material in which glycerine is used will remain substantially the same over long periods of time. It means satisfaction to consumer buyers.

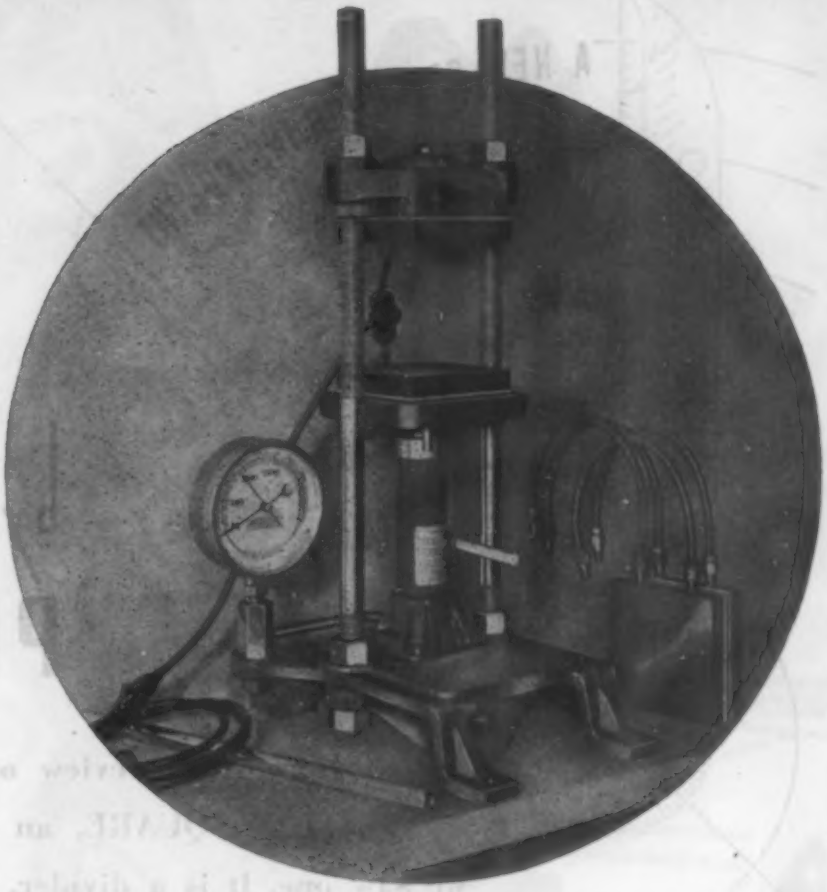
Low vapor pressure, high viscosity, non-toxicity, high solvent power, compatibility, and other valuable properties, plus economy, make glycerine a superior humectant. Use glycerine, which is now freely available for the production of civilian goods. Glycerine Producers' Association, 295 Madison Avenue, New York 17, N. Y., Dept. J-7.

Better Cosmetics—thanks to soothing C. P. glycerine, which helps to keep skin soft and smooth. Think of glycerine, now freely available, when you plan new products. Use it—and be *sure!*

Better Pharmaceuticals—thanks to C. P. glycerine, the tried and tested ingredient, proved through generations of use. Use crystal-clear glycerine in the formulation of your products—and be *sure!*

THE CARVER LABORATORY PRESS

STANDARD FOR RESEARCH AND DEVELOPMENT



Milestones in Plastics

In 1872, experiments revealed that a condensation product could be formed from the interaction of aldehydes and phenols. But it was not until 1909, following a period of sustained study and laboratory work, that a patent was issued, indicating that a heat-hardenable resin could be produced by using an alkaline catalyst. This event led to intensive development in the plastics industry. Numerous phenolic resins now produced under various proprietary names suggest the importance of this branch of the plastics family. Large quantities of phenolic plastics are used in the automotive, radio, communication and aircraft industries.

Industrial progress can be slow and arduous or rapid and expansive, according to the intensity and extent of its research and experimental work. Rewards of persistent laboratory research are shown by plastics development. Annual plastics production between 1925 and 1940 increased more than 5 times, while the number of new plastic compositions introduced in this period was more than double the number brought out during the first 55 years. An ever-present aid in plastics research during the past 15 years has been the Carver Laboratory Press. This press is standard

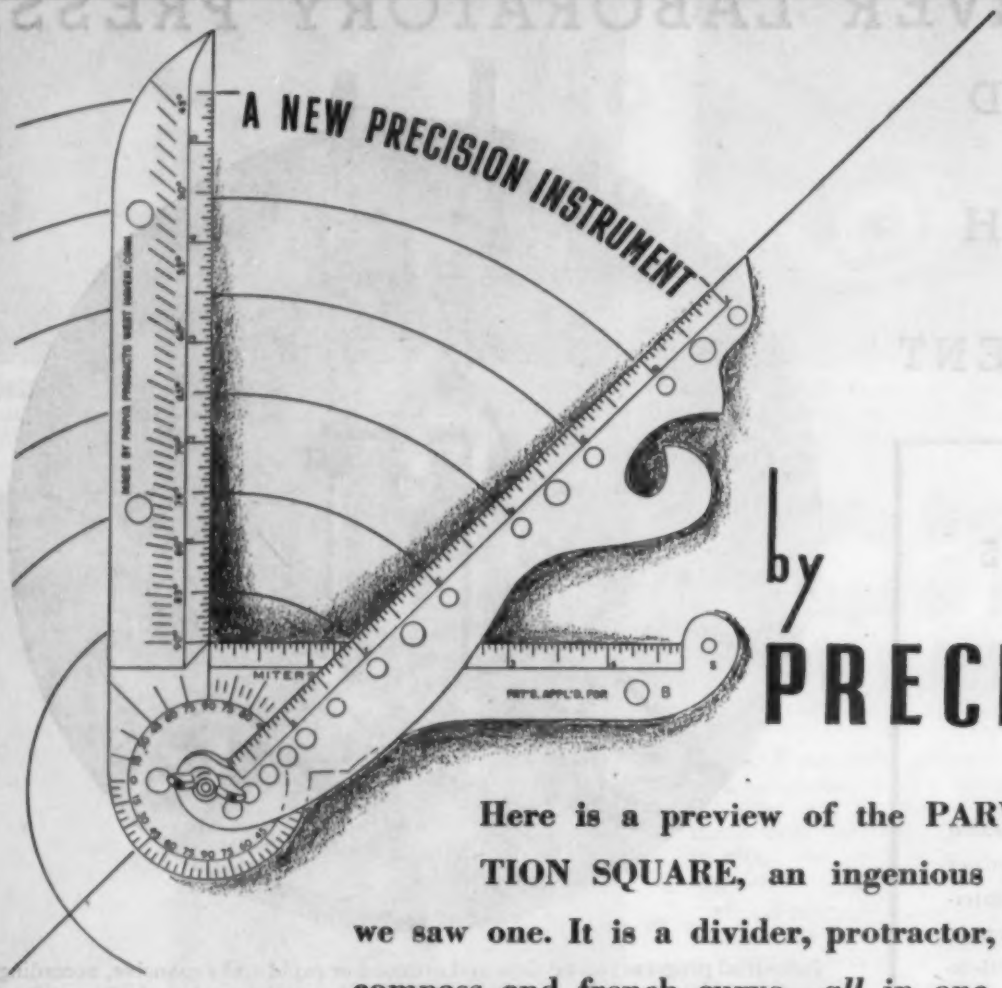
- **for making quick and accurate small-scale pressing tests.**
- **for development, research and instruction work.**
- **for testing single cavity molds.**
- **for preparation of samples.**
- **and even for small-scale production.**

Original in design, the Carver Laboratory Press is small, compact,

- **has a pressing capacity of 20,000 lbs.**
- **weighs only 125 lbs.**
- **operates under self-contained hydraulic unit, giving any precise variations in pressure that may be desired.**
- **large accurate gauge of finest construction is rigidly mounted on base.**
- **special gauges are available for low pressure work.**

Carver Press accessories include electric and steam hot plates and test cylinders or molds. Also standard interchangeable accessories are available for general research—cage equipment, bearing plates, filtering equipment, etc. PROMPT DELIVERIES. Send now for latest catalog.

FRED S. CARVER
HYDRAULIC EQUIPMENT
343 HUDSON ST., NEW YORK 14



by PRECISION

Here is a preview of the PARVA COMBINATION SQUARE, an ingenious device if ever we saw one. It is a divider, protractor, triangle, ruler, compass and french curve—*all in one.*

We show it simply as an example of the kind of problems we will be solving after the war. And to make such a precision instrument in plastic *was* a problem, for obviously the tolerances had to be very close, and the molding exactly controlled to avoid warping. Equally important from the manufacturers' standpoint, we will be able to provide a perfect combination of quality, volume and price.

If you're at all interested in plastics, keep that name "PRECISION" in mind. We'll be available the minute Peace whistles blow.

PPC

PRECISION *Plastics Company*

4647-61 STENTON AVE. PHILADELPHIA 44, PA.

Planned Perfection

Behind "locked doors" the experimental engineers work on your design problems exploiting the broad electrical mechanical experience that has contributed so much in the development of electronics and related products. With privacy assured, the combined resources of Cinch from field engineer to designing technician, make the Cinch part in your product "like the doctor ordered" . . . and with the same professional guardedness. A long line of firsts is conclusive testimony of the confidence that our customers have in Cinch. Have you taken advantage of our development services?

CINCH MANUFACTURING CORPORATION

2335 W. Van Buren Street, Chicago, Illinois

Subsidiary of United-Carr Fastener Corp., Cambridge, Mass.

No. 3 in a Series of advertisements "MEET MEtal Plastics Engineering"

WHY TRANSFER MOLDING IMPROVES APPEARANCE

Besides economy and intricate inserts, the patented transfer molding process achieves better appearing thermosetting plastic parts. Just as finishing costs are reduced, so is plastic beauty unspoiled.

Take, for instance, the hand wheel at right, used for control of electrical apparatus. The application calls for a high-strength, cloth-filled compound. If molded by compression, this compound would lay in the "lands" of the mold, preventing a complete pinch-off and leaving a rough, ragged parting line. After an expensive knife-cleaning operation to cut the cloth, the piece would be left with a very ragged surface and an unfinished appearance.

Molded by transfer, the compound is heated in a chamber connected with the mold, which is closed. It then flows through sprues on the back of the part. Only a small amount of resin can escape at the parting line, leaving a line without dimension. After curing, the mold is opened for easy removal of the part. Finishing consists merely of a brief touch-up with a blunt tool to remove the resin fin, which was along the circumference of the wheel.

SHAW

SHAW INSULATOR COMPANY

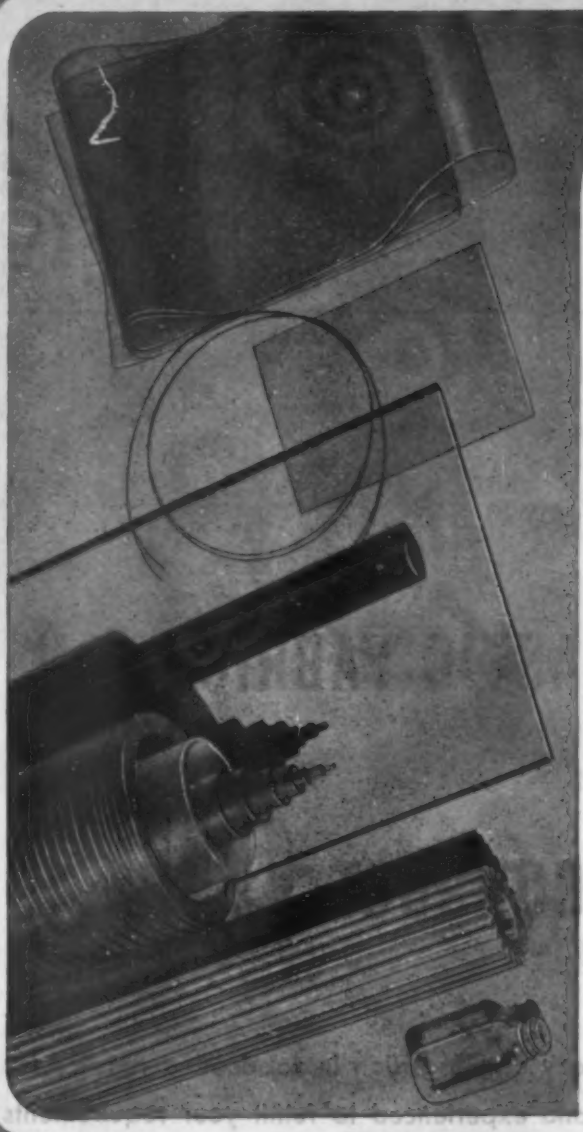
169 COIT STREET, ★ IRVINGTON 11, NEW JERSEY

Licensed transfer molders offer the advantages of this patented process. A list of nearby licensees will be sent on request.

Available literature includes two bulletins on "Why Transfer Molding is Economical", one on "Why Transfer Molding Gives Fine Inserts", and reprints of technical articles by Shaw engineers.

A broad range of plastic processes and materials is covered by Shaw and the Plax Corporation, Hartford 5, Conn. Both welcome requests for help in applying plastics to specific needs. For the names of nearby licensed transfer molders or the literature mentioned above . . . write Shaw.

DATA ON POLYSTYRENE FORMS BY PLAX



MECHANICAL

Tensile strength, p.s.i. (A.S.T.M. D 48-37)	5500-7000
Tensile proportional limit, p.s.i. (.01% offset), —38° F.	3700
Tensile proportional limit, p.s.i. (.01% offset), 78° F.	2500
Modulus of elasticity in tension, p.s.i., —38° F.	554,000
Modulus of elasticity in tension, p.s.i., 78° F.	469,000
Modulus of elasticity in compression, 78° F., p.s.i.	560,000
Compressive proportional limit, p.s.i. (.01% offset)	2600
Compressive strength, p.s.i.	15,200
Rockwell hardness (½-in. ball, 60-kg. load)	R90-R97

ELECTRICAL

Volume resistivity, ohm-cm	10^{17}
Arc resistance (A.S.T.M. D495-38T), sec.	120-140
Dielectric strength, volts per mil, .005 in. thickness	3500
Dielectric strength, volts per mil, .010 in. thickness	2500
Dielectric strength, volts per mil, .015 in. thickness	2200
Dielectric strength, volts per mil, .125 in. thickness	500-700

Frequency	Dielectric Constant	Power Factor
60 cycles	2.5-2.6	.0001-.0002
10^3 cycles	2.5-2.6	.0001-.0002
10^6 cycles	2.5-2.6	.0001-.0004
10^{10} cycles	2.5-2.6	.0002-.0004

Corona voltage = 85,000

THERMAL

Distortion temperature (A.S.T.M. D48-37), °F. (°C.)	176-194	(80-90)
Transition temp., °F. (°C.)	180	(82)
Softening point, °F. (°C.)	220-240	(104-116)
Ignition point, °F. (°C.)	1350	(732)
Specific heat, cal. per gr. per °C.		.32
Thermal expansion coefficient, per °C.		7.2×10^{-5}
Thermal conductivity, cal. per sec. per cm. per °C.		3.2×10^{-4}
Burning rate		Low

PHYSICAL

Light transmission (.10 in. thick), %	90
Refractive index, n_D^{25}	1.59
Specific gravity	1.052
Specific volume, cu. in. per lb.	26.1
Water absorption in 48 hr.	.0000
Tendency to cold flow	Very slight

CHEMICAL

Effect of:

Weak and strong acids*	None
Weak and strong alkalis	None
Alcohols	None
Esters	Soluble
Oils	Soluble

* Strong oxidizers will discolor.

Plax offers polystyrene, in "water clear" and all colors, in the following forms (shown above from top to bottom): tough, flexible Polyflex* Sheet; tough, flexible Polyflex Fiber; conventional sheet, slab, rod and tube forms; special extruded shapes and bottles.

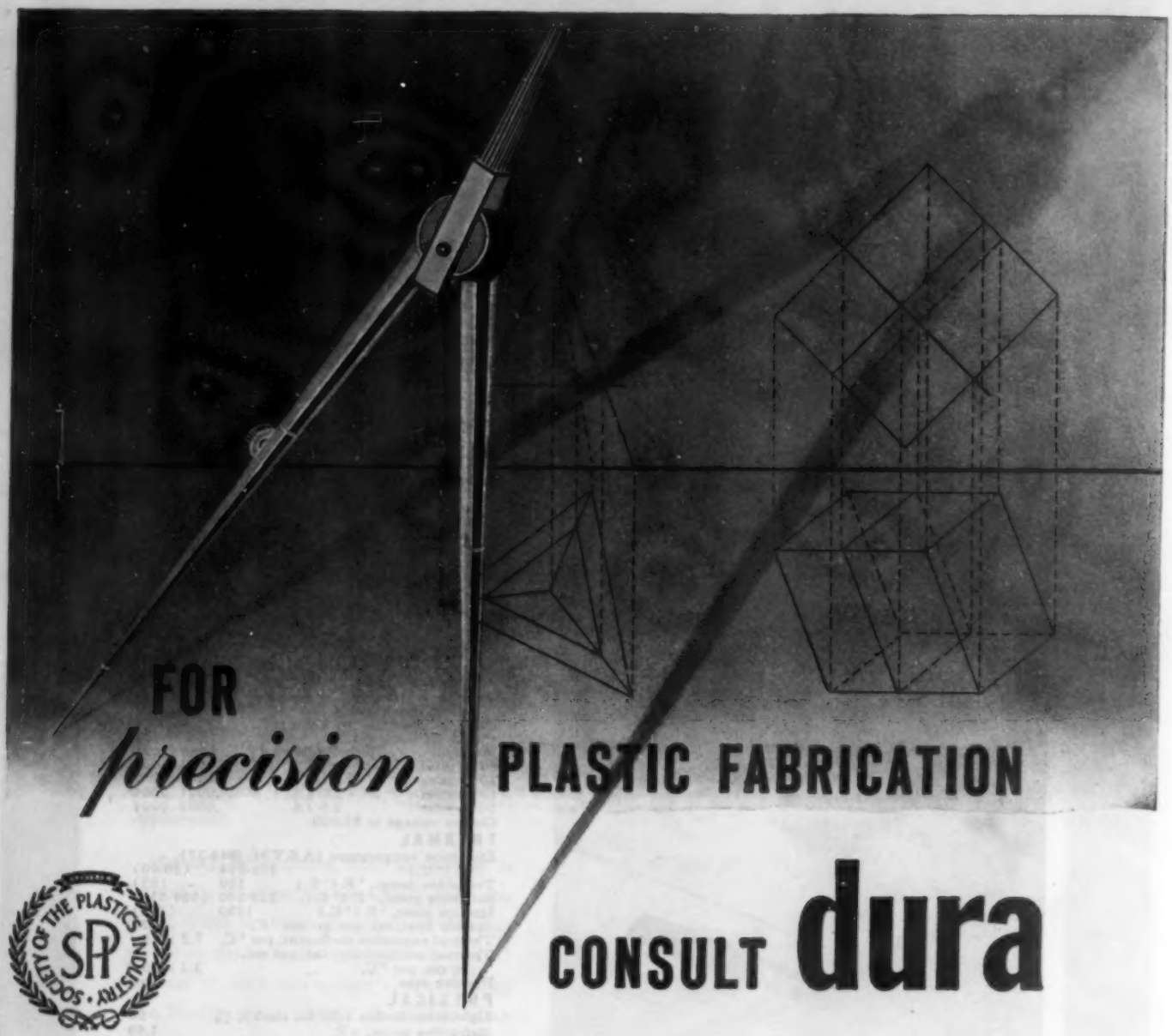
Several bulletins on Plax polystyrene products and how to machine them are available on request.

In cooperation with the Shaw Insulator Company, Irvington 11, N. J., Plax can help you with nearly all plastic materials and methods. For the literature mentioned above . . . write Plax.

* Trade Mark Reg. U.S. Pat. Off.

PLAX
FOR PLASTICS
NOT SUBSTITUTES···IMPROVEMENTS

133 WALNUT STREET ★ HARTFORD 5, CONNECTICUT



FOR *precision* PLASTIC FABRICATION

CONSULT **dura**

Meeting today's demands for accuracy and precision in fabricating plastics for war needs, **dura** is well equipped and experienced to fulfill your requirements when peace returns. The problems met by **dura** today in building vital parts for landing craft, planes and instruments foretell the contributions **dura** will make in peacetime production. Acrylics, laminated phenolics, acetates, styrenes, etc. machined, formed, polished, welded to your specifications. Our assistance and advice is offered freely to interested firms who are looking ahead to postwar opportunities.

NOW IS THE TIME TO CONSULT DURA

dura plastics, inc. 1 WEST 34 STREET, NEW YORK 1, N. Y.

Custom fabricating specialists to the aviation, electronic and shipbuilding industries.

Thousands of Fabricated Parts from Taylor's Sheets, Rods, Tubes

1 *One of several parts for an artificial leg, which is sawed, milled and drilled from a flat sheet of Phenol Fibre.*

2 *Hinge support blocks for the P-51 Mustang fighter planes' elevator trim tabs were created and designed by Taylor engineers.*

3 *Switch spacers, made from tubes of Phenol Fibre, are quickly and accurately finished on a Taylor automatic screw machine.*

From sheets, rods, and tubes of Phenol Fibre or Vulcanized Fibre, Taylor makes thousands of different fabricated parts, turning them out by the millions and doing it quickly, accurately, and economically.

Almost every one of these parts is specially designed for a special purpose and calls for a laminated plastic with special characteristics. Their common feature is light weight with great strength. In addition, they have insulating, electrical, and dielectrical properties unequalled by any other material.

Having been in this business for more than fifty years, Taylor also has a stock of standard tools for turning out such things as plain washers, and shoulder bushings, in so many different sizes that the chances are good that the size *you* need is in stock and your fabricated part can therefore be made more quickly and more inexpensively.

Whatever your problem, our engineers will gladly tell you, without obligation, exactly what Taylor Laminated Plastics can contribute to its solution. Write us today, sending sketch or blueprint.

TAYLOR FIBRE COMPANY

LAMINATED PLASTICS: PHENOL FIBRE • VULCANIZED FIBRE • Sheets, Rods, Tubes, and Fabricated Parts

NORRISTOWN, PENNSYLVANIA • OFFICES IN PRINCIPAL CITIES • PACIFIC COAST HEADQUARTERS: 344 S. SAN PEDRO ST., LOS ANGELES 13

WORKING 24 HOURS A DAY

National 2½" Oil-Heated Extruder is capable of producing from 25 to 75 pounds of extruded materials per hour. Oil heating and cooling system entirely self-contained. Precision thermal equipment assures positive temperature control.

The National Extruder shown above is doing 24-hour-a-day duty at Dunlop Tire and Rubber Goods Company, Ltd., Toronto. Principal product at present is fuel line hose for British and Canadian planes—made from a special British compound of the Polyvinyl Chloride type.

Here are being produced 22 different sizes of fuel hose, ranging in diameter from ¼" to 1¾". And these are held to inside diameter tolerances of very close limits for this type of work.

This flexibility and precision of control is typical of the job National Extruders are doing in plastics manufacturing plants of every type. That's why hundreds of businesses—from paper mills to food processing companies—are evidencing greater and greater interest in this economical, versatile method of plastics parts production.

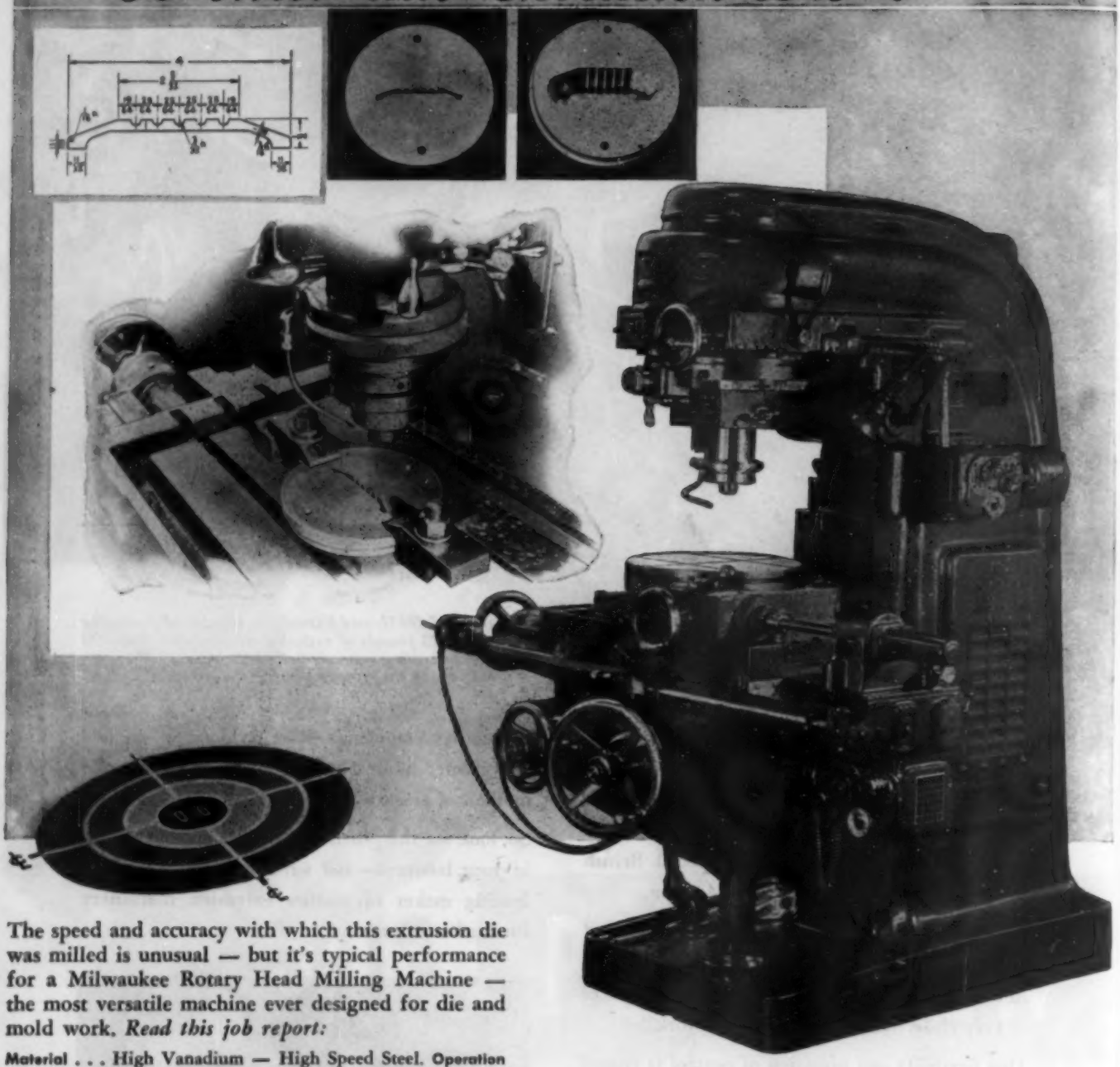
So, look for the possibilities for plastics extrusion in *your* business—and write today to America's leading maker of plastics extrusion machinery for further information.

A few of the many flexible and rigid shapes produced by Dunlop with the National 2½" Oil-Heated Extruder.

NATIONAL RUBBER MACHINERY CO.
General Offices: Akron 11, O.

Plastics
MACHINERY DIVISION

Would You Need More than 10 hours To Mill this Extrusion Die ?



The speed and accuracy with which this extrusion die was milled is unusual — but it's typical performance for a Milwaukee Rotary Head Milling Machine — the most versatile machine ever designed for die and mold work. *Read this job report:*

Material . . . High Vanadium — High Speed Steel. **Operation . . .** machine orifice of extrusion die. **Time Distribution . . .** set up, ¼ hour; layout, ¼ hour; rough mill outline, 3/16" deep, 2 hours; rough drill opening through die, 1 hour; finish mill outline, 3/16", 2½ hours; square cut corners with slotting attachment, ¾ hours; mill lead side of die, 3¼ hours; **Total Time** — 10 hours. No templets were required.

Check these advantages of the Milwaukee Rotary Head Mill Machine and how you can benefit from them in your own shop:

DIRECT — mills mold cavities in a single set-up without the aid of templets or models.

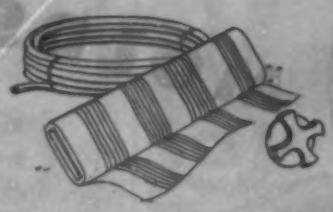
ACCURATE—no changes in set-up eliminates chances for error. Exact control of all combinations of cutting movements — possible only with this machine — transmits mathematical precision to the work.

FAST — initial job preparation and set-up time is reduced to the minimum. Accurate performance of the machine saves operator's time and rapid production of the intricate molds and dies is the result. Write for Bulletin No. 1002C and complete information.

BUILDERS OF MILWAUKEE ROTARY HEAD MILLING MACHINE • MIDGETMILL • SPEEDMILL • FACE MILL GRINDER • AUTOMETRIC JIG BORER • CENTER SCOPE.

Kearney & Trecker
Products
CORPORATION
Milwaukee 14, Wisconsin
Subsidiary of Kearney & Trecker Corporation

SARAN



Present and Potential Uses:

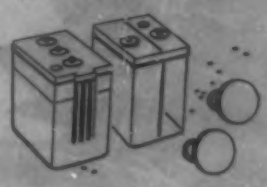
Plating masks; chemical apparatus; pump parts; valves and valve parts; name plates; meter parts; paint brush handles; insulation; stoppers; funnels; bottles; closures; plumbing parts and equipment; wire coating; pipe and tubing for installations requiring chemical and corrosion resistance; monofilament for textiles.

Properties and Advantages:

Resistant to chemicals, abrasion, corrosion, water, and moisture; good electrical insulator; excellent thermal insulator; non-flammable; tough; flexible; dimensionally stable; not recommended for installations requiring temperature resistance above 170° Fahrenheit.

STYRON

(DOW POLYSTRENE)



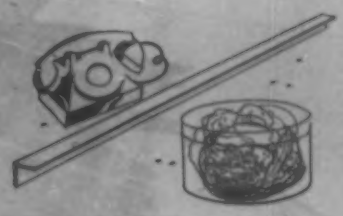
Present and Potential Uses:

Lighting fixtures; insulators; battery cases; hydrometers; funnels; closures; food handling equipment; pharmaceutical, cosmetic and jewelry containers; costume jewelry; novelties; refrigeration parts; pens; pencils; liquor dispensers; escutcheons; chemical apparatus; dishes; lenses; decorative objects, trim.

Properties and Advantages:

Clear, translucent or opaque; broad color range; excellent high frequency electrical insulator; can "pipe" light through rod at angles, and around corners; resistant to acids and many alkalies; low water absorption; light weight; stable at low temperatures.

ETHOCEL



Present and Potential Uses:

Housings; radio cabinets; aircraft parts; containers; insulators; flashlights; automotive parts; escutcheons; refrigerator parts; tool handles; rods, tubes, bars, and special extruded shapes for kitchen trim; automotive and aircraft window frames; modern window blinds. Also used as tape and wire coating.

Properties and Advantages:

Extra tough, particularly at low temperatures; attractive colors; pleasant to handle; transparent or translucent; dimensionally stable to varying climatic conditions and temperatures; light in weight; available in wide range of flow; not available in crystal color.

PLASTICS

STYRALOY 22—new synthetic elastomer now available.

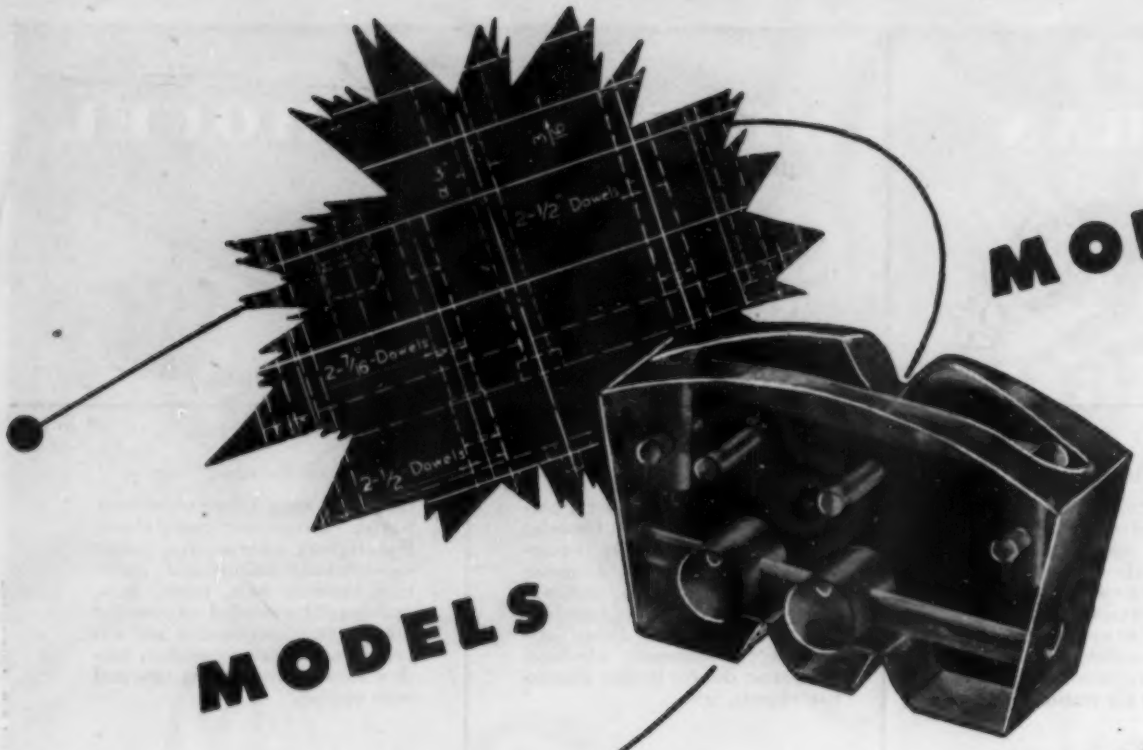
PRESENT AND POTENTIAL USES: One-piece cable sheathing; handles for tools, household appliances, etc.; gaskets; bushings; coil forms; floor mats; scuff plates; many applications still to be ascertained.

PROPERTIES AND ADVANTAGES: High dielectric strength, low power loss over all frequencies. Power factor only .005 at 100-300 megacycles. Flexible and shock resistant from—90° F. to 212° F. Specific gravity less than 1 (floats in water). Water absorption only 2 to 5%. Resists heat, ozone, and most chemicals. Highly resistant to abrasion. Resists permanent indentation. Ideally suited to extrusion of complex cross sections and readily fabricated by other molding techniques. Easily machined.

DOW

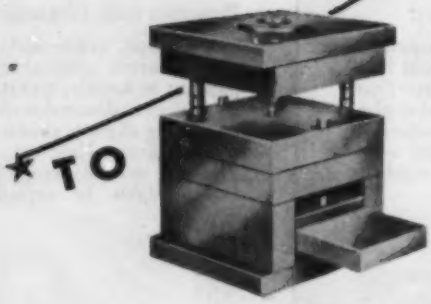
PLASTICS

STYRON • STYRALOY • ETHOCEL • ETHOCEL SHEETING
SARAN • SARAN FILM • STRIPCOAT



MODELS

MOLDS



TO YOUR SPECIFICATIONS

Tri-dimensional models for movable or stationary parts are now available from the hands of our highly skilled experts in plastics (transparent, opaque, etc.), metal, and wood for study, experimentation, sales promotion or demonstration.

We are also equipped to provide a complete product development service from the inception of the idea through blueprints and models to the finished mold by men with long years of experience with leading model and mold makers. Molds machined to extremely close tolerances are available for all types of molding—Injection, Compression and Transfer.

MODELS AVAILABLE IMMEDIATELY...

Bring your idea or blueprint to us today.

CECO

CONDOR ENGINEERING CO.

TOOLMAKERS TO THE PLASTIC INDUSTRY

384 SECOND AVENUE · NEW YORK 10, N. Y. · GRAMERCY 3-2887

IF you want a high-melting modifier or extender that is compatible with most natural or synthetic plastic resins—and *immediately available*—specify Vinsol Resin! Supplies of this dark-colored thermoplastic are now plentiful, and the cost is but 2½ to 3½ cents per pound delivered!

Vinsol Resin conserves critical molding and laminating materials, while saving time and money. Vinsol Resin extends shellac and phenolics for compression-molding, and is useful in cold-molded plastics. It is miscible with glycerols. It improves flow of lignin plastics.

Test Vinsol Resin and prove for yourself its savings in time, money, materials. Coupon brings a generous test sample and detailed properties.

NV-55

HERCULES

*Reg. U. S. Pat. Off. by Hercules Powder Company

RETURN COUPON FOR FREE SAMPLE

NAVAL STORES DEPARTMENT
HERCULES POWDER COMPANY
INCORPORATED
916 MARKET STREET, WILMINGTON 99, DELAWARE

Please send further details on Vinsol Resin ☐ sample ☐
I am interested in this material for.....
.....
Name..... Title.....
Company.....
Street Address.....
City..... State.....

LIGHT but **TOUGH!**

High Acetyl Cellulose Acetate, formulated by Chemaco has exceptional versatility in meeting rigid military and industrial specifications, as well as in forming a multitude of civilian items.

While it has the toughness, color and lustrous finish of standard Chemaco Cellulose Acetate, it has additional fine properties which add to its general utility. The dimensional stability is considerably improved because of increased resistance to heat and moisture. Like standard cellulose acetate it can be formulated to be tasteless, odorless and non-toxic.

Both standard and high acetyl cellulose acetate are available in all colors and in an unusually brilliant crystal. The colors may be obtained in transparent, translucent and opaque shades. Chemaco Cellulose Acetate lends itself to a vast variety of uses from trims and edgings in extruded form to flashlight cases, plumbing fixtures and personal accessories such as toothbrushes, combs, cosmetic containers and jewelry items.

Chemaco engineers will be glad to advise you on the correct materials and formulae to meet your specifications. Chemaco molding compounds include thermoplastics with a wide variety of properties and capabilities. Ask about Chemaco Ethyl Cellulose, Polystyrene and Vinyl Compounds.

Chemaco Corporation

A subsidiary of Manufacturers Chemical Corporation

Berkeley Heights, N. J.

Branch Office—Cleveland, Ohio

LEA *METHODS*
LEA *COMPOSITIONS*

Remove Burrs and Fins *QUICKLY—ECONOMICALLY*

These hand grips go on many of our Army and Navy Bombers for controlling turret gun firing, communications and turret rotation. They have to be as smooth as glass. Parting lines of matched sections must not have any ridges or depressions.

To help bring about these desired results, Plastic Manufacturers use the Lea Method with a special Lea Composition for one of the steps in removing roughness from the edges of the molded parts. The "before" and "after" pictures are of this step.

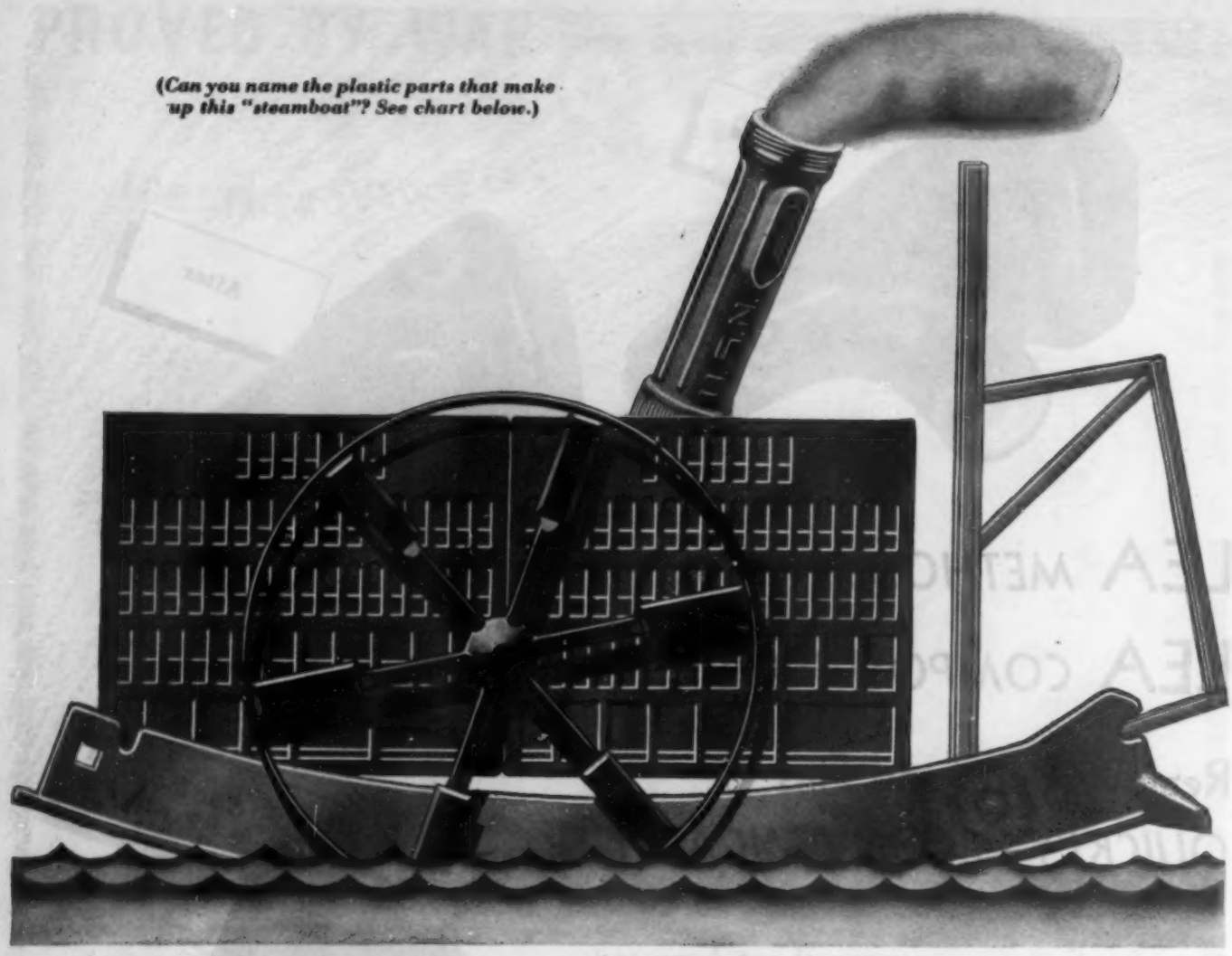
In ever-increasing number, molders and converters of plastics are turning to LEA for improved techniques and proper compositions for removing burrs and fins as well as buffing the molded parts. If you are not satisfied with results or costs in your plant, why not put your problem up to our technical staff?

This is the way Plastic Manufacturers, Inc., of Stamford, Conn., removes Sanding Marks from Phenolic Molded Grips.

The LEA Manufacturing Co. WATERBURY 86, CONN.

Barring, Buffing and Polishing . . Manufacturers and Specialists in the Development of Production Methods and Compositions

(Can you name the plastic parts that make up this "steamboat"? See chart below.)



How to put your product on the right course

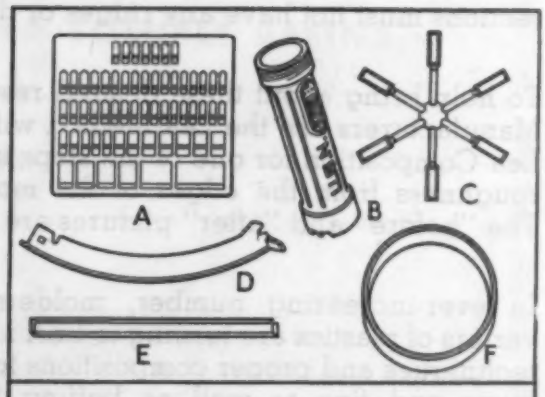
Are you all at sea trying to make a better product? Continental's Plastics Division can steer you right.

Whether you're looking for beauty, durability, lightness, toughness, or anything else in a product, we're fully equipped to do the job. Our complete facilities enable us to plan and turn out products of all sizes, colors and shapes—from buttons to bomb parts, faucets to furniture—each requiring a different technique in design, research and manufacture.

If you're faced with a product problem, Continental's staff of plastics experts can solve it in the shortest possible time at the lowest possible cost.

So count on Continental to give your product the right features. You'll find an alert, progressive organization ready to give sound, practical advice and assistance at all times.

Tune in "REPORT TO THE NATION," every Saturday over coast-to-coast CBS network.



(a) Johansson gage-block case—compression; (b) U. S. Navy flashlight—injection; (c) Drawer pulls—injection; (d) Segment for circular file—injection; (e) Molding—extrusion; (f) Globe base—injection.

CONTINENTAL CAN COMPANY, INC.

PLASTICS DIVISION

HEADQUARTERS: Cambridge, Ohio

Sales Representatives in all Principal Cities

COMPRESSION • INJECTION • EXTRUSION
SHEET FORMING • LAMINATION

Other products of Continental Can Company: metal cans for food and other products; fibre and paper containers; crown caps and cork products; machinery and equipment.

a new standard line of electrode assemblies for dielectric heating . . . 2, 5, and 10 kw

Built in 2, 5 and 10-kw sizes, these Westinghouse electrode assemblies offer new convenience and efficiency for dielectric heating of plastic preforms.

The assemblies may be mounted on standard generators, or matching networks, and the electrodes are interchangeable within the physical limits of the cage.

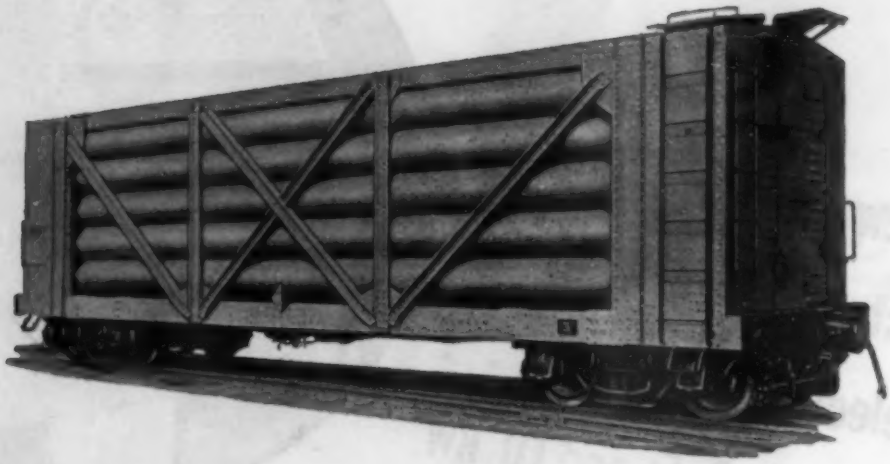
Top electrode is perforated to minimize moisture condensation. In applications where moisture condensation is unusually severe, warm air from the generator may be bled into the cage. This is easily done with Westinghouse generators using air-cooled tubes. Top electrode's height is easily adjusted by a knob on the cage. Ball joint and spring take-up assure positive contact between preform and electrode regardless of material and heating cycles. Interlock switches remove high voltage from bottom electrode when cage is opened.

Available in electrode diameters from 4″ to 15″, depending on kw rating, these newest contributions to effective radio frequency heating may also be built in special designs, on order. Ask your nearest Westinghouse office for the facts. Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa. J-08115

FREE an authoritative, pocket-size reference book on radio frequency heating. Contains extensive tables, charts and formulas on both induction and dielectric heating. Ask for reference book B-3574 on your business letterhead, please.

Westinghouse

Electronics at Work



The car that couldn't be built

GATX GENERAL AMERICAN

The helium car gives you an idea of the way General American tank car designers can go to work for you.

Bulk transportation of helium gas offered great problems, required a car that would withstand a pressure of 2250 pounds to the square inch. General American engineered a revolutionary type of car to meet this need, and now helium cars have given efficient transportation service for many years.

You may have a new, equally hard-to-handle product. Call on General American for bulk transportation that will be safe, sure, and low in cost.

Planning Now with Tomorrow's Leaders

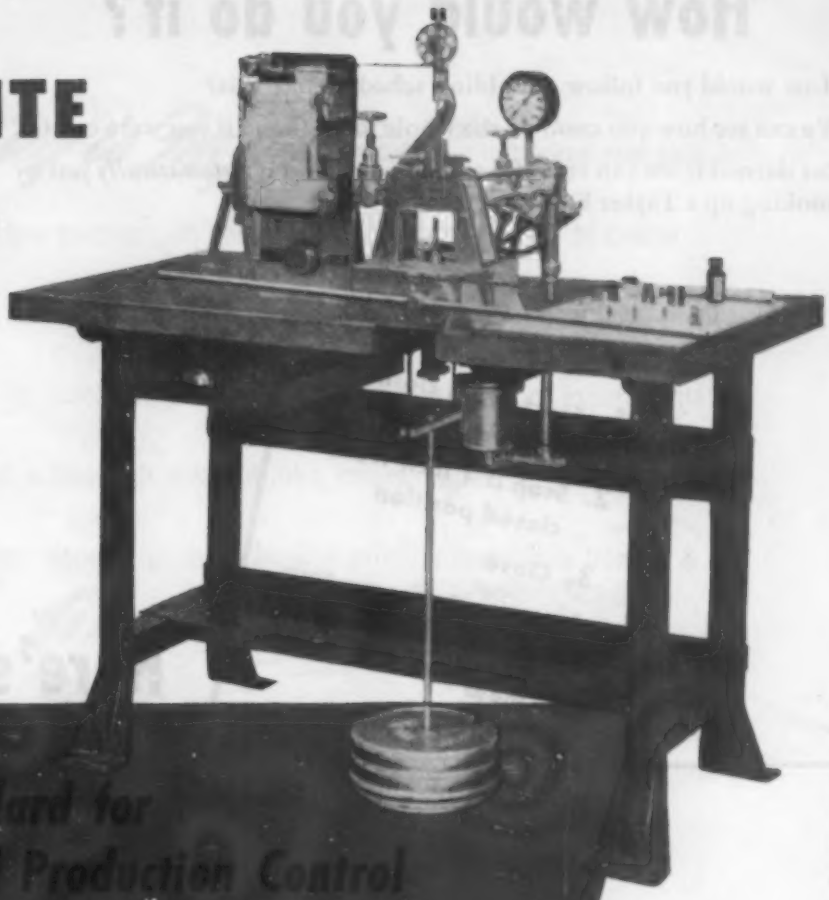
Even though your new product or problem commodity is still in the laboratory stage, General American engineers are ready to work with you now. Keeping pace with your progress, we will plan the new tank car with every feature needed for safe, economical transportation.

Call or write our general offices—135 South LaSalle St., Chicago 90, Ill.

GENERAL AMERICAN TRANSPORTATION CORPORATION

Builders and Operators of Specialized Railroad Freight Cars ★ Built Liquid Storage Terminals ★ Pressure Vessels and other Welded Equipment ★ Aerocoach Motor Coaches ★ Process Equipment of all kinds ★ Fruit and Vegetable Precooling Service

OLSEN-BAKELITE PLASTIC FLOW TESTER



The Recognized Standard for Laboratory Testing and Production Control

What the Olsen-Bakelite Flow Tester Does:

1. Provides for controlling and varying the temperature as it is being applied to the material being tested.
2. Provides for application of pressure in units of 100 lbs. per square inch up to 3,000 lbs. per square inch.
3. Determines the plasticity properties while these changing conditions are taking place.
4. Assures an accurate means of observing and recording the results of such changes. For this purpose an automatic recording device is furnished.
5. Thus the machine plots the flow of the material against time.

Proving every day that the value of testing depends on the quality of the testing equipment.

TINIUS OLSEN TESTING MACHINE CO.
550 NORTH TWELFTH ST., PHILADELPHIA 23, PA.

How would you do it?

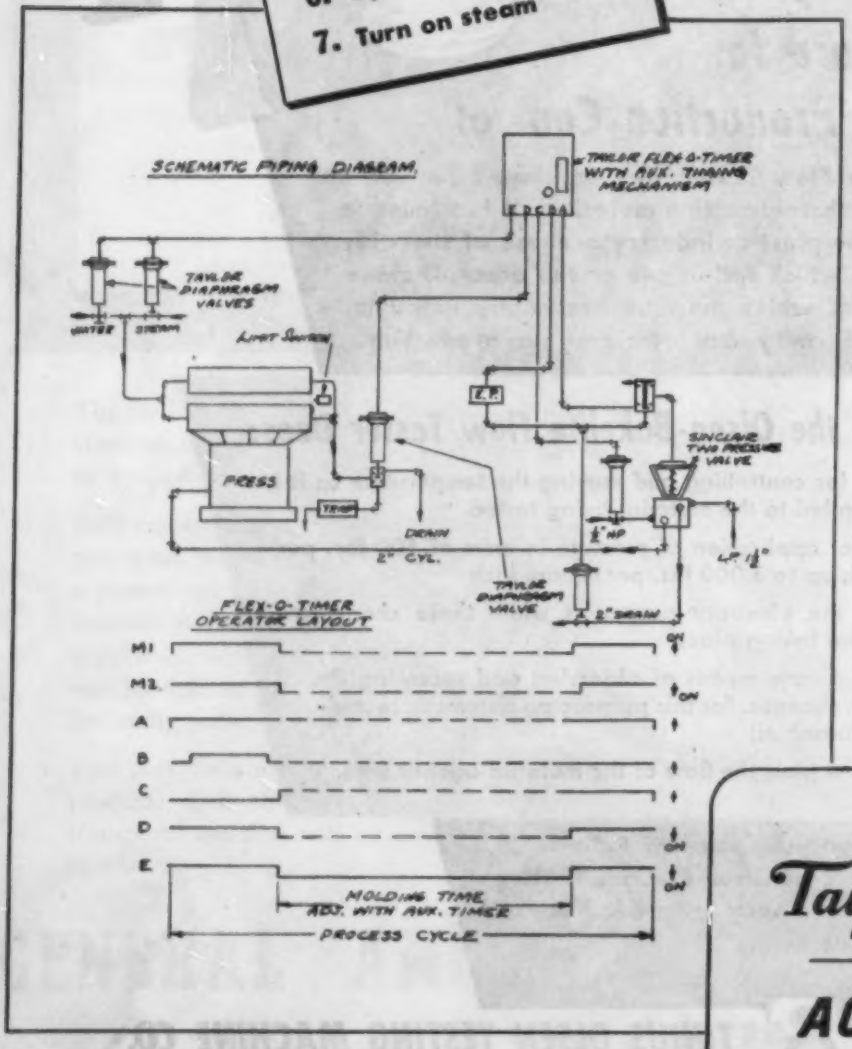
How would you follow a molding schedule like this?

We can see how you *could* do the whole job by hand if you were careful.

But darned if we can see *why*, when you can do it *automatically* just by hooking up a Taylor Flex-O-Timer!

1. Start press closing—steam in on platens
2. Stop it 1 inch from closed position
3. Close
4. Shut off steam—turn on water
5. Mold
6. Open press
7. Turn on steam

Here's how we'd do it!



WHAT we do is lay out the piping as shown at left, and set up the Taylor Flex-O-Timer so it literally "takes charge" of the whole molding operation. This takes time, but *you* don't have to do it—*we* do. And once you get a setup like this, you can adapt it to any experimental changes, any new materials you want to try. It assures consistently uniform quality from each press load, less lost time between loads, and increased production from each working day.

This particular hookup may not be of terrific interest to you. But it's a good illustration of the flexibility of the Taylor Flex-O-Timer—an instrument that can put automatic precision into almost any plastic molding process. Ask your Taylor Field Engineer! Taylor Instrument Companies, Rochester, N. Y. and Toronto, Canada.

ARMY ★ NAVY

Taylor Instruments

MEAN

ACCURACY FIRST

IN HOME AND INDUSTRY

THIS IS NO TIME TO STOP BUYING WAR BONDS

Printing is Important It takes real skill to

print a corrugated shipping box correctly, to combine colors harmoniously, to create designs that appeal, attract, advertise, and sell. Yes, it takes plenty of know how, plenty of experience, plenty of doing. Good box printing is the result of years of experimentation and testing. It's the result of a thorough study of inks, colors, paper stocks, plate work and presswork. You can depend on high quality printing everytime from H & D.

H&D Post-War Packaging Idea . . . DE LUXE PRINTING

Good printing is as important for your shipping boxes as for anything else. The design, whether it features your company name or trade-mark or whether it is a sales display, adds real value to the package as a whole. To be sure you are getting quality box printing, send for a copy of the H & D booklet, "Pack to Attract."

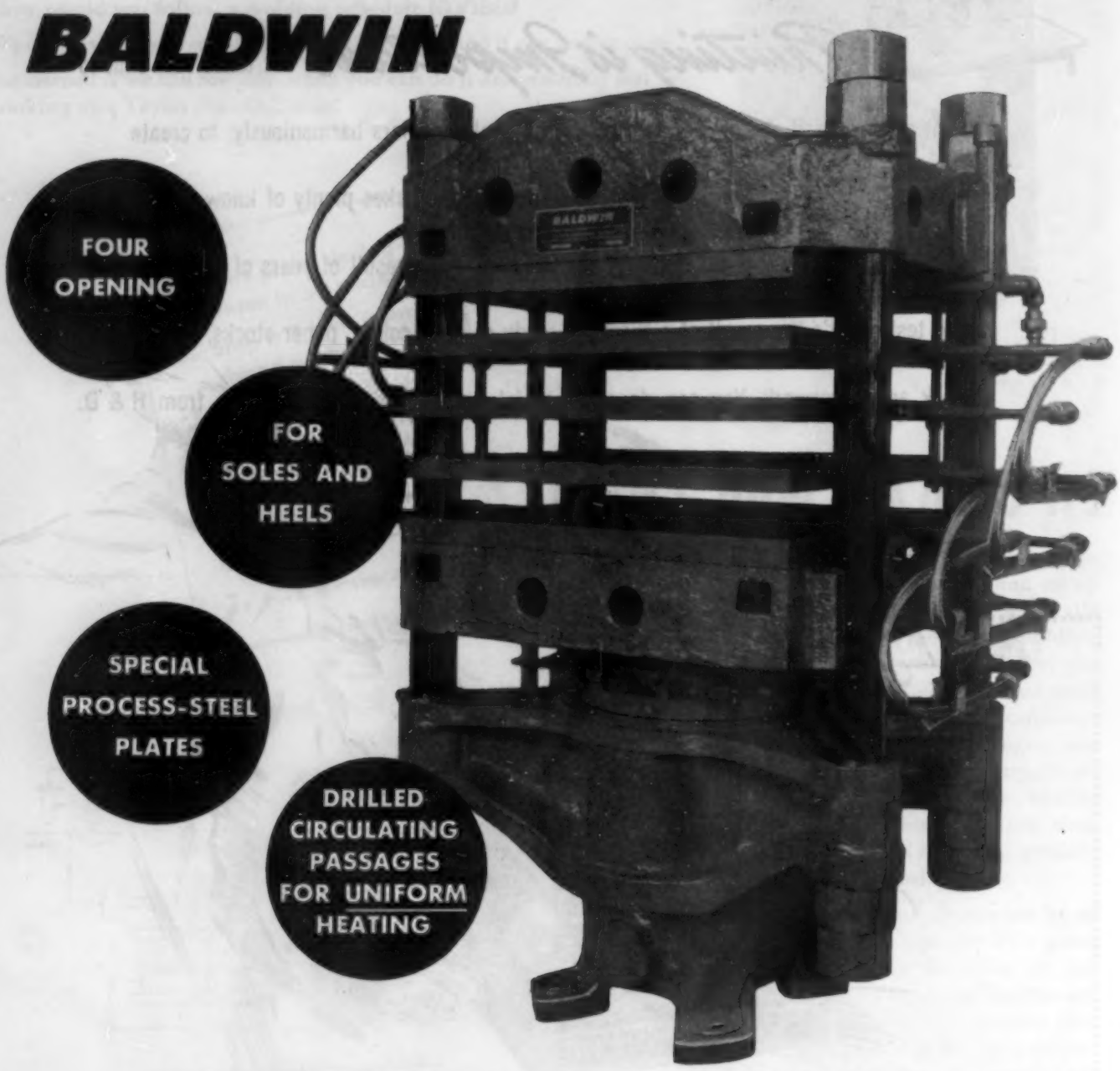
Hinde & Dauch

AUTHORITY ON PACKAGING

THE HINDE & DAUCH PAPER COMPANY, 4538 DECATUR STREET, SANDUSKY, OHIO

Factories in BALTIMORE • BOSTON • BUFFALO • CHICAGO • CLEVELAND • DETROIT • GLOUCESTER, N. J. HOBOKEN • KANSAS CITY • LENOIR, N. C. • MONTREAL • RICHMOND • ST. LOUIS • SANDUSKY OHIO • TORONTO

Another production stimulator from BALDWIN



Here's another new Baldwin press that is helping a large manufacturer to meet today's needs . . . and tomorrow's competition. One of the many quality features is the circulating system. Ducts are drilled from the solid metal, and properly spaced to give uniform heating. The unit is equipped with elevators, necessary hose connections, cast steel main members, ground columns, machined guides and separate inlet and exhaust manifolds. This press is especially suited for any process requiring heating and cooling.

Baldwin presses are advanced in design, give you your postwar equipment *now*. Our engineers will design and build the press to do the job you have in mind. The Baldwin Locomotive Works, Baldwin Southwark Division, Philadelphia 42, Pa., U. S. A. Offices: Philadelphia, New York, Chicago, Washington, Boston, Cleveland, St. Louis, San Francisco, Houston, Pittsburgh, Detroit.

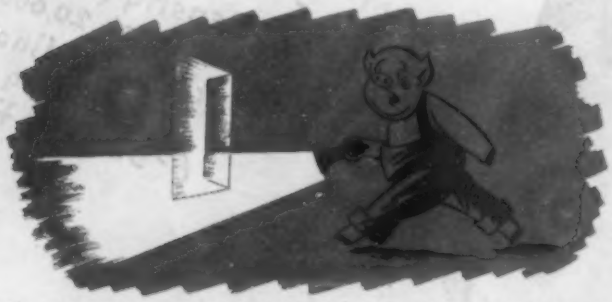
BLW THE BALDWIN GROUP

BALDWIN

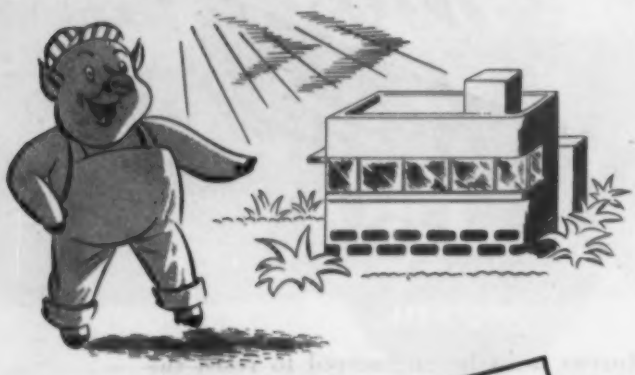
HYDRAULIC PRESSES

The THREE LITTLE PIGS and PLASTICS

THIS is a fable for grownups about three little pigs. Piggy No. 1 built a house of colored wax. It was bright and colorful and when the sun hit it, it melted right down to a lump.



Pig No. 2 was strictly a thermosetting man. He ordered a compression molded job that was solid and sturdy but he forgot to put windows in it and it was too dark to live in.



Our No. 3 pig was cautious but smart. He looked at a lot of materials before he selected his. So his house was built of brick and stone, plywood and plastics, brass and copper and a lot of other things best for their particular functions. He used a lot of extruded plastics for furniture, decorations, refrigeration, piping, insulation, etc. And he had a house that is standing to this day, a monument to intelligent selection.

Moral: The right material in the right place does not mean plastics for everything. As extruders (the first in the field) and injection molders, we can help guide your choice.

DETROIT MACOID CORPORATION

12340 Cloverdale Ave.
Detroit, Michigan

SOCIETY OF THE PLASTICS INDUSTRY · SPI

ORIGINATORS OF
DRY PROCESS PLASTIC EXTRUSION

PLASTIN*

VINYL-ALUMINUM MOISTURE-VAPOR BARRIER

PRODUCTION OF PLASTIN **is currently devoted to filling the unprecedented military demands for this unprecedented moisture-vapor barrier, which surpasses all Type I barrier requirements for maximum load limits under Method II packaging.**

The time will come—perhaps very soon—when Plastin can fill *your* needs for positive protection against corrosion. Samples adequate for introductory and testing purposes are now available. Learn why Plastin is preferred to any other moisture-vapor barrier heretofore known. Send for folder containing description and small samples of Plastin.

PLASTIC FILM CORPORATION

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PLASTIC FILM CORPORATION
475 Fifth Avenue
New York 17, New York

Gentlemen:

Please send a free copy of "An Introduction to Plastin" to:

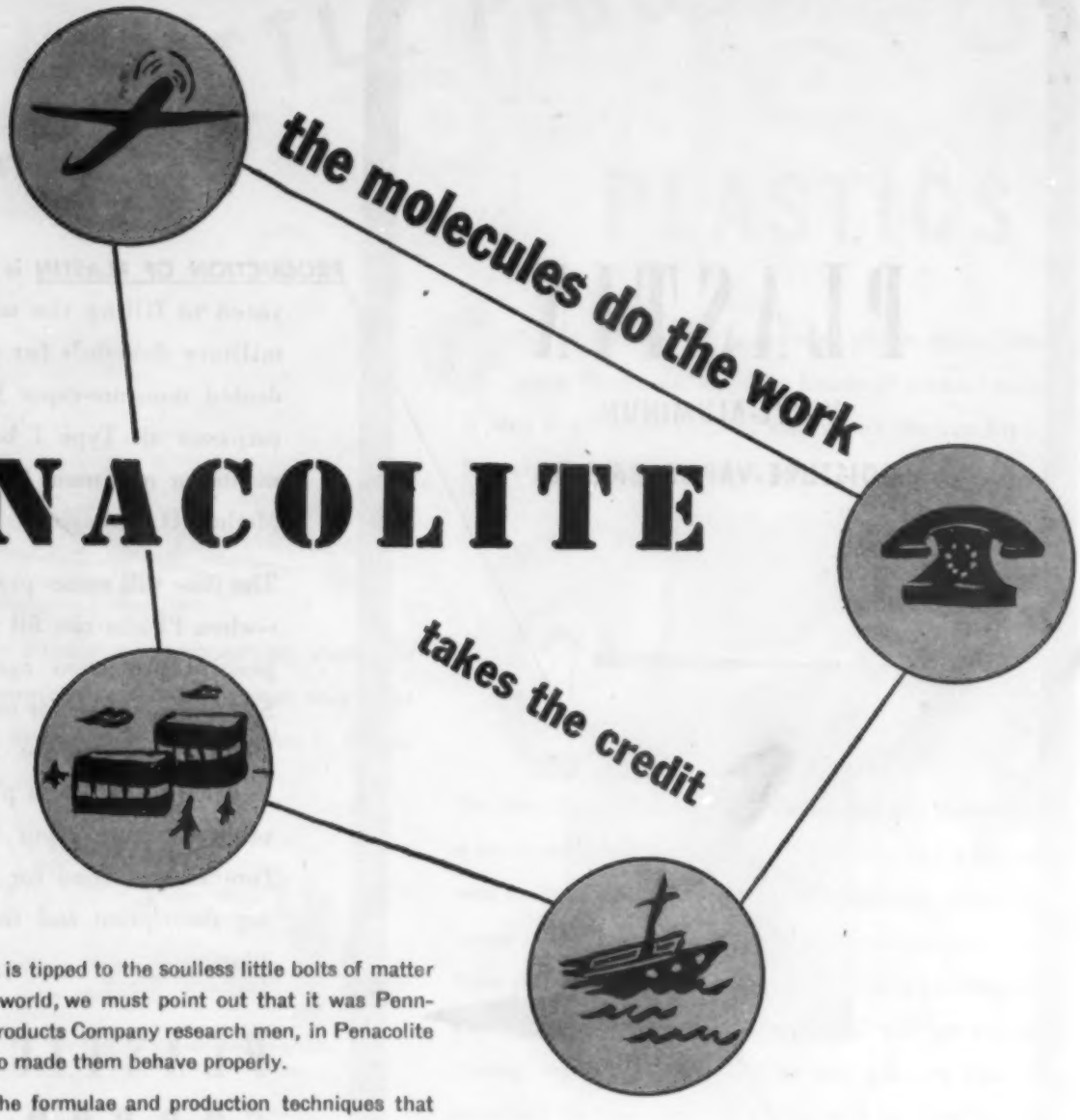
NAME_____ TITLE_____

COMPANY_____

ADDRESS_____

*Patents Pending
Trade Mark Reg. U.S. Pat. Off.

FILL OUT AND MAIL TODAY!



Though our hat is tipped to the soulless little bolts of matter that move the world, we must point out that it was Pennsylvania Coal Products Company research men, in Penacolite laboratories who made them behave properly.

In developing the formulae and production techniques that made possible low temperature, neutral phenolic adhesives . . . in evolving the first commercially feasible resorcin adhesive, it was our "know how" born of years of experience that turned the trick.

Resin users daily depend upon that same experience. When faced with problems in resins (phenol, urea, melamine, resorcin, and aldehydes) they consult us, confident of impartial answers, tailored to their process and its economics.

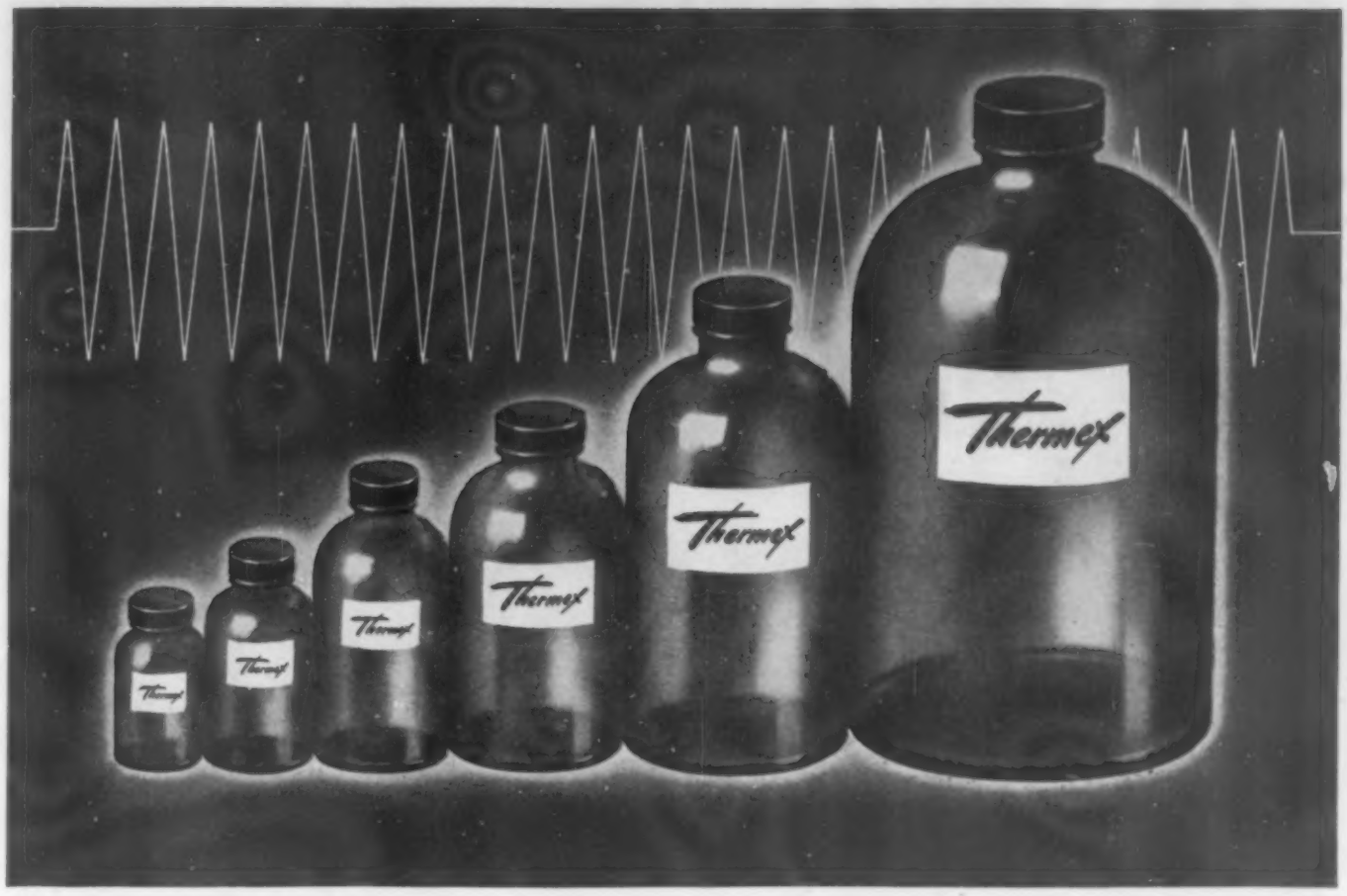
Frankly, we benefit more from the solution of their problems than they do. For it is our constant contact with problems in the field that enriches our background and permits us to keep the quality and performance of our own products outstanding.

For Complete Information:

PENNSYLVANIA COAL PRODUCTS COMPANY

PETROLIA, PENNSYLVANIA

55 West 42nd Street, New York, N. Y.



If high frequency energy came in bottles

—the range of capacities offered by Thermex would look like this. Not one, not two, but six fully developed Thermex units, designed especially for the high frequency heating of plastic materials, are available. In addition to the general advantages of high frequency heat, Thermex gives you the specific advantage of selecting to meet your particular needs from the most complete line in the field. Find out about Thermex! Mail the coupon.

THE FIRST INDUSTRIAL HIGH FREQUENCY DIELECTRIC HEATING EQUIPMENT

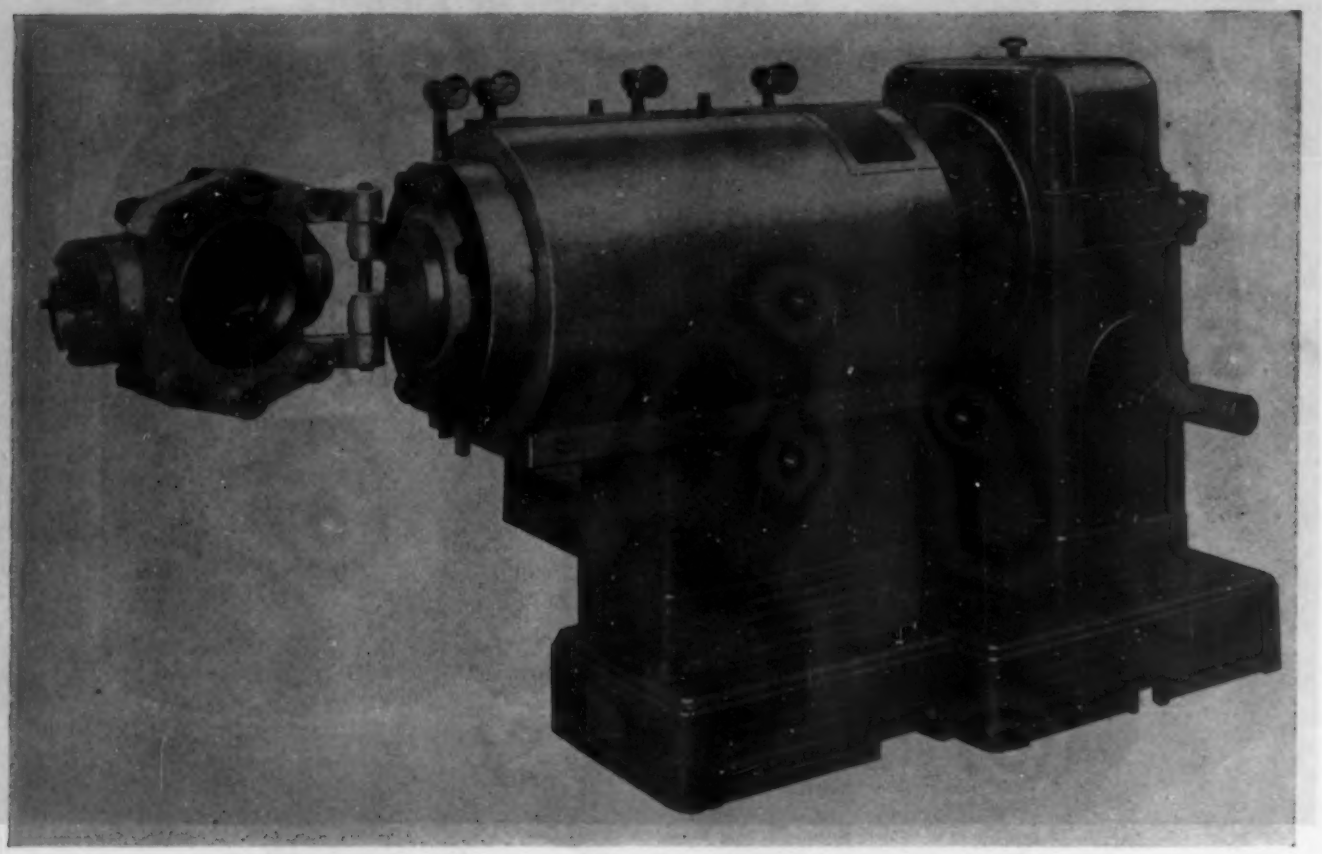
Thermex RED HEADS BY GIRDLER

The Girdler Corporation, THERMEX DIVISION, Dept. MP-6, Louisville 1, Ky.
Please send complete information about Thermex RED HEADS.

Name.....

Firm Name and Address.....

.....



65 YEARS OF PROGRESSIVE PIONEERING

Beginning with the invention of the screw-type machine in 1880 John Royle & Sons have pioneered constantly in the development of continuous extrusion equipment.

Essentially the continous extrusion process hasn't changed a great deal. There have been refinements—the most apparent being in the field of temperature control and in the development of accessory equipment.

Sixty-five years of progressive pioneering have produced a wealth of knowledge and experience. This "know-how" is built into Royle equipment—reflected in perfomance records.

JOHN ROYLE & SONS

ROYLE PATERSON N. J.

PIONEER BUILDERS OF EXTRUSION MACHINES SINCE 1880

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James Day (Machinery) Ltd.
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Home Office
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SHerwood 2-8262

Akron, Ohio
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UNiversity 3726

PATERSON 3, NEW JERSEY

ingeneering*

NOW...FOR THE AGE OF FLIGHT TOMORROW

A postwar sky giant's lightest structural load will be its plastics parts. From tiny corrosion-resistant fittings and transparent, flexible fuel lines to colorful, decorative panels, seats and upholstery, specialized plastics will give greater permanence at a fraction of the weight of the materials they replace.

INGENEERING* by Victory Plastics Company has resulted in unique, compression-molded plastics laminations that are adaptable to numerous uses in the aviation industry . . . And to other industries . . . your industry . . . similar applications of ingenuity to the creation, design and fabrication of postwar plastics products will give you advantages over competition. Victory Plastics Company, 80 Scabbard Street, Hudson, Massachusetts.

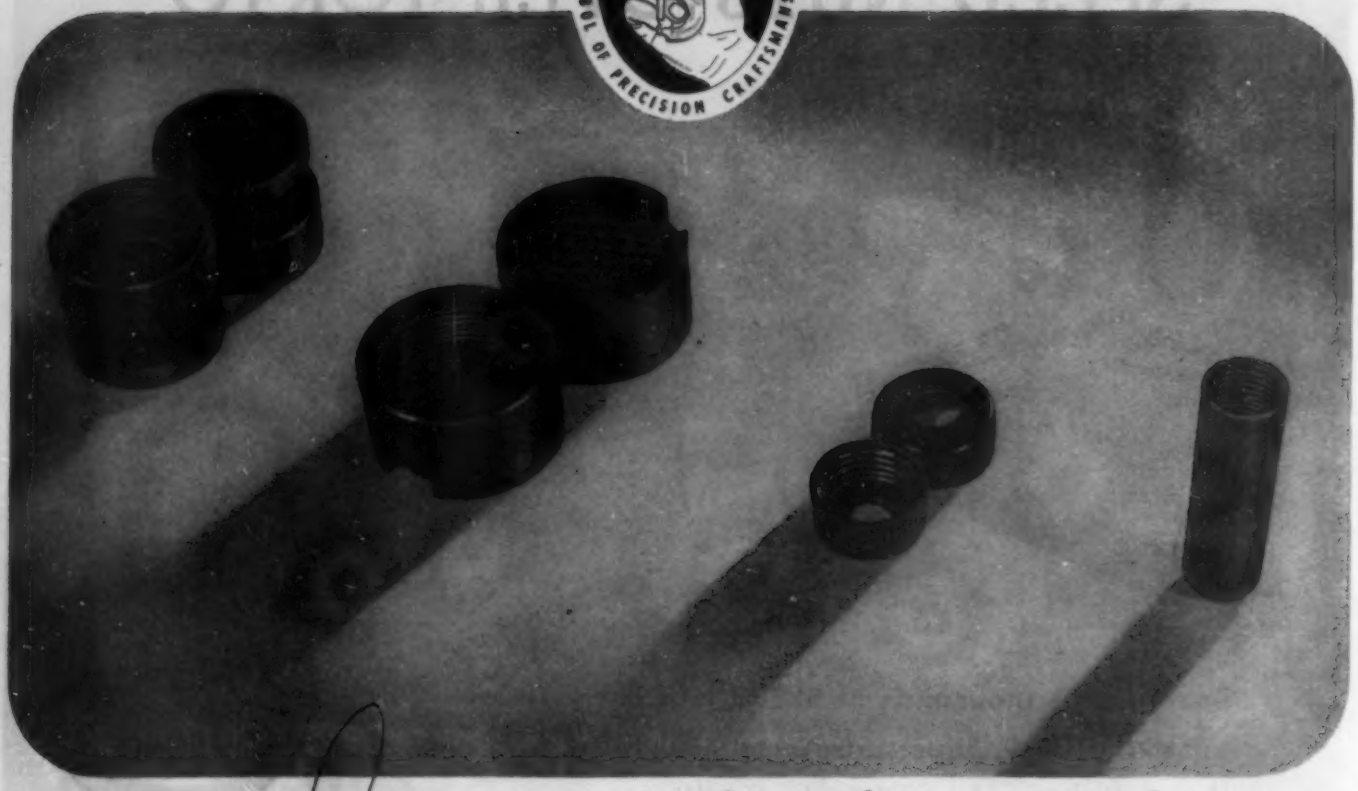
INGENEERS OF PLASTICS PRODUCTS

Victory PLASTICS COMPANY

COMPRESSION • TRANSFER • INJECTION • LAMINATION • SATURATION

Santay

SYMBOL OF PRECISION CRAFTSMANSHIP



Internal threads

A high degree of skill and precision in *making the molds* is essential in producing successful thermo-plastic parts with internal threads. Perfect alignment is a requisite. Tolerances must be infinitesimal. ★ Santay Craftsmen are widely known for the superior excellence of the molds they make. Whether it's a single or multiple 16 to 20 cavity mold of intricate design, only fully automatic unwinding mechanisms are used! Threaded parts screw and unscrew easily, *smoothly!* ★ Don't take chances. If you have a part or product in which internal threads are involved, submit it to our capable plastic engineers. Get the benefit of our 25 years experience in producing better molds.

INJECTION MOLDING AND METAL STAMPING • ELECTRO-MECHANICAL ASSEMBLIES

SANTAY CORPORATION 355 NORTH CRAWFORD AVE., CHICAGO 24, ILLINOIS

FORMERLY SINKO TOOL & MANUFACTURING CO.

REPRESENTATIVES: POTTER & DUGAN, INC., 29 WILKESON STREET, BUFFALO 2, NEW YORK • PAUL SELLER, 7779 CORTLAND AVENUE, DETROIT 4, MICHIGAN • QUEISSER BROS., 108 E. NINTH STREET, INDIANAPOLIS 2, INDIANA

Framed in Features

*NEW... THE 1 KW MEGATHERM**

Here is the Megatherm you have been waiting for . . . a compact dielectric heating unit designed for maximum performance.

Ideal for production line use in plastics processing... quick, uniform heating of plastic preforms permits free flow conditions in the mold . . . allows lowered closing pressures.

Fitting easily between molding presses, the new Megatherm is only 20 inches wide . . . mounted on smooth-running casters with a special lock down feature.

The Megatherm MD-1A is versatile . . . handles a wide range of materials and work sizes . . . heats plastics, rubber, rubber substitutes, wood, glue and other dielectrics . . . defrosts frozen foods, and shows great possibilities in the sterilization of pharmaceutical and similar products.

Write now on your company letterhead for data on the NEW 1 KW MEGATHERM.

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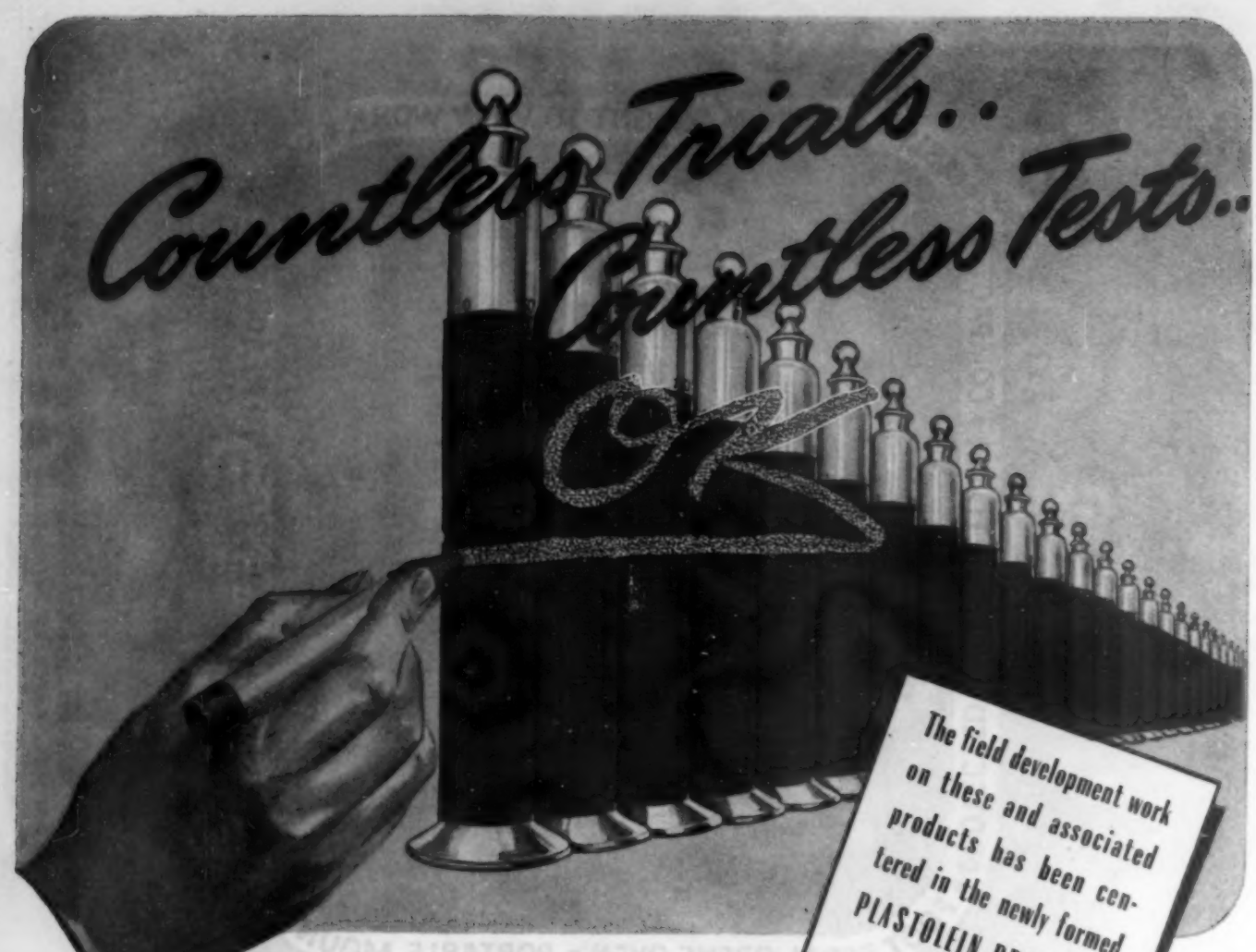
Federal Telephone and Radio Corporation

*Reg. U. S. Pat. Office

AN IT&T ASSOCIATE

Newark 1, N. J.



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MODERN PLASTICS

VOLUME 22 JUNE 1945 NUMBER 10

The industry speaks its mind

As the over-all military campaign approaches its crisis, a thousand major problems have to be resolved. The governments of the great nations have met and will meet again to determine their solution and to lay the foundations for universal cooperation and world security.

The idealistic efforts which these conferences and plans represent, establish the pattern for all postwar thinking, whether the aim be a world order or the security of a single segment. In either case there is realization that we must not make the same mistakes again, that the course of future events will be measured by conscious and careful recapitulation of past errors and omissions.

Toward this end, MODERN PLASTICS in its March issue tried to put down on paper sentiments that plastics men have often expressed:* that the plastics industry halt and identify itself, inspect its ranks, and consider where it is going and how best to proceed. As a target at which active minds might shoot their ideas, a tentative program was presented for the industry's inspection.

We realized then, as we do now, that some of the proposals were Utopian and beyond the immediate reach of industry activity, but we hoped they might serve to focus the industry's attention upon itself and particularly upon the evils within it. The program was deliberately provocative and broad in outline, designed to bring to light the constructive plans which had been shelved for the duration of the busy wartime period and to draw out any latent ideas.

We urged the plastics industry to state its own case and offered these pages as a vehicle for bringing individual reactions to the attention of the entire group. By telephone by wire, by mail, at luncheon and dinner meetings, we received comments. Some writers argued each point, some sent us sweeping approvals, some offered concrete suggestions or proposed new agenda. The sum total of all of their replies represents a cross section of the industry's thinking, and we are proud to act as an intermediary for the dissemination of these diversified ideas.

In the summary below, we present the high points of the plastics industry's self-analysis—what plastics men think must be done and how they think the desired results may logically be accomplished. In every instance we quote directly from the letters which we received and, wherever permissible, we have indicated the source of the quotation.

* "Propaganda . . . a threat or a boost," MODERN PLASTICS, *22*, 93 (March 1945).

A Positive Platform

Any series of idealistic precepts is effective only to the extent to which it is translated into positive action. In these pages, the original ten proposals outlined for the plastics industry's consideration and several additional suggestions which have been submitted by its members are put before you.

Whatever the final platform—a synthesis of all these suggestions or a radically different program—the plastics industry must set the machinery in motion now in order to insure its own protection and growth at the war's end. Concerted action along definitely prescribed lines, with final goals clearly established, will be the media which will determine the fulfillment of its tremendous promise.

The need for action

The most authentic evidence that the time is propitious for industry action is the fact that more than 10 percent of the industry responded to our invitation to state their views, and of these written commentaries on the editorial, 93 percent expressed approval of the program. Eighty percent of that 93 percent endorsed all ten points without reservation. Only 3 percent of those replying flatly rejected the program, while the remaining 4 percent made no definite commitment.

Since so many replies took as their premise the specific points mentioned in the original editorial, we shall continue to refer to them as a guide in classifying the recommendations made by industry members. These ten points are:

1. Expose current misleading theories, unqualified opinions and all exaggerations.
2. Direct attention to reliable channels of information.
3. Share technical knowledge with the industry.
4. Eliminate the "chiselers."
5. Outline opportunities for investment and labor.
6. Prepare for competition by reducing the basic costs of both materials and manufacture.
7. Base price quotations on prearranged uniform standard factors.
8. Admit the limitations of plastics and reject unsuitable applications.
9. Adopt the standard grades of commercial types of plastics and identify them for purposes of reference by simple chemical terminology.
10. Undertake a program of consumer education to illustrate what plastics materials will and will not be able to do.

The suggestions which stimulated the most significant reactions were Nos. 1, 2, 3, 8, 9, 10 as analyzed below. While the syntheses of opinion on these original points can provide the basis for further discussion, a few additional

proposals, daring in concept, merit particular attention, since the same basic ideas appear to have been conceived independently by several individuals in the industry.

A central council—a seal of approval

Most startling of all was the proposition that an industry-supported and -governed impartial institute be set up which would serve as a clearing house for problems arising within the industry. In addition, it might set up a bureau of standards and bestow a seal of approval or, perhaps, a stamp of endorsement on specific consumer products and primarily those items which are intended for consumer sale. While there was some divergence of opinion as to exactly what type of agency this might be or how it might be established, 18 percent of those who commented advocated similar organizations and 11 percent specifically prescribed the seal of endorsement. This remarkable unison of thought is voiced in the following letters which, like all others in this article, have been cut and edited because of space limitations.

For example, J. F. Corwin, Chemical Director, Casein Co. of America, suggests that a "Plastics Institute, similar to the Good Housekeeping Institute, be established to sponsor or refuse to sponsor, certain plastics items that would be bought by the general public." A variation of this idea was offered by W. H. McHale, advertising manager, Plastics Div., American Cyanamid Co., who suggested that a committee might be formed composed of duly-elected representatives of such groups as the raw materials producers, molders, fabricators and possibly the retailers, which would undertake to scan uses and perhaps be helpful in starting a program of consumer education.

A "plastic underwriters' laboratory, equipped and staffed to make reliable and unbiased acceptance tests on consumer products and issue authorization certificates and labels," was recommended by George DeBell, consulting engineer. F. R. Loetscher, manager, Plastics Div., Farley & Loetscher Mfg. Co., believes, as do several others, that the consumer could be trained to look for such a label of approval. He urged that "any product which is sold as a plastics product carry an approval stamp of a plastics association, such as S.P.I. or P.M.M.A."

An additional suggestion—as brought out in many letters, particularly those from E. B. Stratton, Jr., Washington representative, Plaskon Div., Libby-Owens-Ford Glass Co.; W. E. Moore, Plastics Research Products Labs.; and H. M. Abbott, vice-president, Hardesty Chemical Co., Inc.—proposed that the industry promote the acceptance of a seal of approval through publicity and advertising in newspapers and magazines, display posters and other public channels.

Start reform within home territory

With the idea of self-regulation as the first step necessary to help eliminate the threat to the plastics industry's reputation and development, about 10 percent of those who replied suggested that the industry begin to create order in its own sphere. It was urged that the industry establish rules and ethical standards for itself before embarking on a more general educational program.

The adoption of standard practices was offered by C. J. Romieux, sales manager, Plastics Div., American Cyanamid Co., who expressed the opinion that "much can be done to improve the position of our industry by the adoption of standard practices." Mr. Romieux believes that "a laudable effort in this direction is being made by the Technical Subcommittees of S.P.I." Similarly, D. Gray Maxwell, Waterbury Companies, writes: "I feel that there is a lot of educational work to be done by P.M.M.A. with the fabricators. A lot of faults have originated right at the fabricators' door either through lack of knowledge or interest."

D. L. Gibb, manager, Plastics Engineering Div., Dow Chemical Co., suggests that "the easiest place to attack any evil is at the point where the fewest individuals need be contacted. Possibly this point is the sales force of the materials supplier. If we can indoctrinate our salesmen with the notion that they should promote the sale of plastic materials only for jobs wherein their specific materials will be satisfactory, and if we can get them to discourage the use of plastics where they are not suitable, then I think we can do a good job to build up a good name for these materials."

"Closer cooperation of molders, as an industry group, will help sift out the people who have been causing the upset condition," said F. W. Howard, sales manager, Firestone Rubber and Latex Products Co., who proposed that the plastics industry be established on the same basis as that on which the rubber industry is set up.

Stress positive achievements

It was felt by some that the industry might overdo the present phase of "deglamorizing or debunking" and overemphasize limitations to such an extent that the public might become confused, prejudiced and overcautious in its attitude toward plastics. Over 12 percent of those sending in replies stressed the importance of a positive campaign. They urged the industry to shout about the outstanding applications and the desirable properties which plastic materials possess and to build up any plastics achievements honestly with proof of actual accomplishment.

"In our attempt to be conservative, let us not be negative in our thinking or advertising," warns E. K. Krueger, president, King Plastics Corp. "The time for the plastics industry to become ultra-conservative and universally considered as such will be after it is a hundred years old."

R. E. Brannan, division sales manager, Molding Materials, Bakelite Corp., cited cabinets and washing-machine agitators as particular applications where plastics were considered unstable in the early stages of development. He went on to point out that, by continued emphasis on the good points of plastics, coupled with constructive suggestions for proper design of molds and selection of material, it has been possible to convince engineering groups that plastics had potentialities when properly handled.

Expose misleading theories, exaggerations, opinions

This suggestion (No. 1) was endorsed by 89 percent of those replying, although 6 percent qualified their remarks by advising that a general committee be formed by industry associations to counteract by effective action, unwelcome and damaging publicity.

Two industry members who exhorted organized groups within the industry to carry the burden of refuting inaccuracies, were H. Kline, manager and technical director, Phenolic Plastics Div., Reichhold Chemicals, Inc., and H. S. Spencer, advertising manager, Durez Plastics and Chemicals, Inc.

Mr. Spencer felt that letters should be addressed to the publishers or writers of misleading statements or articles, and Mr. Kline proposed that local plastics groups review manuscripts prior to publication.

J. E. Wolfe, general manager, Plastics Div., Continental Can Co., Inc., urged that "reputable forces be combined to lobby against unethical practices," and that "the decks be

cleared of all the experts who are throwing hogwash into the ears of the buying public." However, several readers either questioned the practicality of controlling advertising, publicity, etc., or felt that it might be better to see plastics continue to be a subject of popular and of industrial interest rather than to have the interest fade away. One letter argued that it might be difficult to judge correctly what constituted "misleading theories," as the impossibilities of today might conceivably become accomplished facts in the future.

Direct attention to reliable channels of information

There was almost unanimous acceptance of this point (No. 2) as part of general consumer and industry education. Many remarked that there existed at present authoritative literature, both general and technical in nature, and that informative films, brochures and manuals could be obtained.

L. S. Stout, Professor of Chemical Engineering, Washington University, St. Louis, offered the idea that specialized training in chemical engineering be seriously considered by undergraduates looking for opportunities in plastics, because abbreviated courses of study often produce only amateurs.*

Share technical knowledge

Referring to this suggestion (No. 3), many urged that organized technical groups and industry associations take the lead in explaining sound utilization of new plastic materials, machinery and processes, and in pooling "know-how."

The activities of technical and research committees along these lines was reviewed by some of their members. P. H. Rhodes, chief of resin research, Pennsylvania Coal Products Co., declared that "the excellent cooperation which has developed in the Resin Adhesives Division of P.M.M.A., has shown that it is possible for highly competitive manufacturers to work together to improve products in the field."

W. B. Hoey, national president, Society of Plastics Engineers, said that S.P.E. was encouraging engineers from other fields to participate in its activities in order to help them understand plastics and, incidentally, "to help some of us in plastics to learn more about the problems of the end-users."

Eliminate chiselers, reduce prices, standardize quotations

There was practically no dissension on these points (Nos. 4, 6, 7). All agreed it was eminently desirable to eliminate the chiselers and exploiters of plastics, to establish uniform accounting and sound business practices in quoting on jobs, and to bring prices within competitive range of other materials. It was generally felt that the growth of the industry plus the inevitable mass demand for products would contribute to the reduction of prices, as production costs were lowered.

As for the chiselers, the "Central Institute" and endorsement stamp mentioned previously would presumably help to force them to toe the line as would cooperation with Better Business Bureaus. In addition, a thorough, aggressive campaign for direct consumer education might prevent exploiters, since an informed public can't be fooled.

Outline opportunities for investment and labor

This suggestion (No. 5) was considered important but not immediately necessary. Some characterized the idea as a "banking or investment problem," although one correspondent felt that the organizations within the industry might cooperate with Better Business Bureaus in exposing many schemes developed by unscrupulous operators to interest investors ignorant of plastics. In addition, agencies might be established to supply information to persons seeking to put money in plastics' enterprises.

Adopt standard grades of plastics, simplify terms

This suggestion (No. 9) was recommended by 95 percent of the respondents, although some qualified their endorsements. Others advocated Federal regulations dealing with proper labeling of materials, or Governmental standards for specific grades. For the most part the idea of simple nomenclature for commercial types of plastics was correlated with the broader platform of consumer education.

There was some skepticism regarding the feasibility of achieving complete simplification. F. A. Abbiati, general manager of sales, Plastics Div., Monsanto Chemical Co., writes: "Since there is such a variation in the formulations supplied by the various raw materials producers, I seriously question whether it would be possible to identify these materials by chemical name without being misleading. Standardization is grand when products are approximately equal."

Admit limitations of plastics, reject unsuitable applications

Most of the writers were in favor of careful selection of jobs for plastics materials (No. 8). Most agreed that both the plastics man and the manufacturer who intended to use plastics for the whole or part of a product should be well informed about the materials, particular about the design and judicious in choosing the molding or fabricating process.

The need for a positive tone in admitting limitations, as mentioned previously, was stressed; and it was urged that even when it was necessary to reject unsuitable projects for plastics, the plastics representative do a selling job on good points, which might be considered for other applications.

T. E. Richards, Midwest Molding & Mfg. Co., declared: "Some of us in the industry are afraid to admit that plastics have any shortcomings and therefore take on many unsuitable applications, thus further poisoning the minds of our 'on the fence' users. In this regard, perhaps a resolution brought before the next S.P.I. annual meeting might help to bring this point home to the offenders."

Undertake a program of consumer education

Fundamentally, there was 100 percent endorsement of the idea that a direct program of consumer education (No. 10)

Since this article was written, the American Society for Testing Materials has announced a new program for testing goods designed for consumer use which should contribute greatly to their standardization. A Committee on Ultimate Consumer Goods, whose members are drawn from the Society's standing committees, will apply standard A.S.T.M. tests to such materials at the specific request of consumer groups.

Tests are restricted to those materials sold to end users without processing of a nature which affects their properties—e.g., household blanketing, the quality of which is not changed by cutting it to size and binding it. Most requests so far have been concerned with items in the textile, paint and soap fields. Although the only plastics tested to date are synthetic rubbers and the non-rigid varieties, the program is open to other types which meet the requirements.

* See item on News of the Industry, page 186, in this issue, concerning a program of research and instruction in plastics at Princeton University.

was of paramount importance. Many thought that this project might solve many of the other problems harrassing the industry. The recommendations for putting such a plan into effect ranged from direct advertising and promotion through radio, motion pictures, exhibits, newspaper and magazine articles to the use of informative labels on certain products or seals of approval as discussed above. It was emphasized again and again that the industry approach this problem by stressing the individual, special properties of plastics and illustrating successful usage.

A few of the writers favored direct contact within the limits of their own communities and described their own activities—lectures, open-house for local merchants and manufacturers, and cooperation with schools and business clubs.

R. L. Peat, president, Plastic & Die Cast Products Corp., reports that as soon as the restrictions are lifted on plant visitors, he plans to conduct buyers from larger stores in the vicinity on a tour through his plant, and that he will be willing to serve as consulting engineer to any store buyer who wishes advice on possible plastics applications.

An approach to the housewives, suggested by M. A. Foley, Rayon Processing Co. of R. I., Inc., is a 15-minute morning radio program.

Clinton Rector, general sales manager, Catalin Corp., thinks a 10-minute movie short, skilfully prepared, in order to appeal to local theatre audiences, might clarify the situation by emphasizing the diversity and versatility of plastics.

Laissez-faire

Less than two percent of the respondents were willing to admit that, while the program was interesting, it would be wise to let well enough alone and let the plastics industry rise or fall on its own merits, in the belief that in the postwar period there will be quite a scramble for accessory or industrial work and nobody will pull his punches. Others stated that they believe the industry would eventually solve its problems through growth and postwar development, as have other industries.

A. W. Prance, supervisor, Plastics Departments, Briggs Mfg. Co., claims that, "it would be humanly impossible to police the plastics manufacturers or black-ball some of the chiseling molders, as we must have competitive manufacturing to progress. Experimentation with a slight gamble in production must be taken for advancement in this field."

George K. Scribner, president, Boonton Molding Co., reminds us that abortive civilian applications have appeared in all fields during the war period and that, even with war scarcity and desperate improvisation, plastics are still pioneering in new directions. Some applications are bound to fail, he declares, in spite of the best of preliminary analyses, but "it's better to barge ahead on a shot-gun basis—hoping some shot will hit a worth-while target and the others won't bounce back and hurt us too much." Mr. Scribner agrees that investigations and reports of wartime failures should be continued, but believes it would be futile to hold down rash individuals or to "dare to set up a department to list bad applications, since some percentage of everything falls apart at an embarrassing moment while the rest are plugging on."

Strongly opposed to any negative, defensive approach which might call the customer's attention to the weak points of the industry, Clinton Blount, vice-president and general manager, Bakelite Corp., sums up a policy of "toil and spin" for the plastics industry. Mr. Blount believes that experience, knowledge of what can be done, belief in what may be expected on the basis of information available, hope for fulfillment of expectations, and planning for proper fabrication to obtain the best finished properties of a desired plastics type, are factors to be considered in any course for improvement within the industry.

The next step

The industry has stated its case. However debatable the platform may be, however diversified the approach, it is evident that there is considerable interest and desire to formulate a basic creed and to inaugurate a program of action.

Several of the ideas proposed merit further scrutiny by the industry to determine whether or not they are practical and, if so, what machinery is required for their achievement.

The original ten suggestions may be condensed and altered into an abbreviated course of action satisfactory to the majority of the industry. Certainly, it must be within the bounds of immediate possibility to embark upon a program of education, utilizing the facilities now available—department store exhibits, educational films, the press and the radio.

The moot question of informative labeling, still under investigation by this publication, demands careful attention as a possible means toward achieving a better understanding of plastics and what they will do.

The Central Committee or Standards Bureau might be a joint venture undertaken by all the existing societies in the industry, providing an opportunity not only to advance the plastics industry but also to add to the scope of the trade associations themselves. It is up to the industry to find out whether such an institute is feasible, to measure its value to the industry and to appraise its cost.

No matter how limited its initial achievements may be, an authoritative, united group with a definite plan of action will be preeminently worth while for, although it may not eliminate all vicious practices nor solve all problems overnight, it will symbolize the first brave step.

The plastics industry cannot afford to drift aimlessly without planning for its future. The importance of an invention here, a development there, is only as great as the sum total of all the industry's efforts. What is essential then, is not to correct each careless inaccuracy, each outburst of derisive propaganda, but to see to it that there is understanding and appreciation of the products the industry has to offer. The engineer who places an order, the copywriter who describes the product, the salesclerk, the reporter and the ultimate consumer will be able to deal with plastics if he knows what they are and what they can do, and he will be able to deal with literary distortions and shoddy merchandise with equal understanding.

The industry recognizes its responsibilities and admits its deficiencies. The course is clear, the need urgent, and cooperation paramount. It is not the responsibility of any one member of the industry, nor of a single group, but of the entire membership to participate actively. Each must do his part, and have a voice in the final decision.

To that end, MODERN PLASTICS, offers its columns as a medium of exchange, a clearing house for ideas of anyone seriously interested in the welfare of the plastics industry. An invitation is therefore extended to all readers to make use of these facilities in making known any constructive suggestions for the accomplishment of the industry's aims, or to augment or comment upon the proposals discussed in this article.

We shall continue to investigate as many promising projects as possible and to report, not only upon our own studies but upon the activities of agencies within the industry. We pledge our support to any positive realistic program.

Kitchen prototype—designed for plastics

The extent to which plastics will be able to capture the postwar consumer market depends not only upon the properties and special qualities of the materials but also upon the originality and soundness of their application. To indicate to potential users some of the materials at their disposal and to inspire original ideas for postwar manufacture, the Dow Chemical Co. engaged Peter Müller-Munk, industrial designer, to create some thought-provoking products in cooperation with company engineers, research and sales specialists. This article is the first of a series which will illustrate the designs resulting from this association.

NO rugged pioneer wife, awaiting the arrival of her first new-fangled, mail-order gas range, was ever more impatient than the modern housewife expectantly saving her pin money for the purchase of a "miracle" peacetime kitchen. Tantalized by hints of fabulous materials and incredible inventions—lustrous colorful plastics, featherweight metals, shatterproof glass, resin-treated wood, magical electronics, radio-telephony—she anticipates that all the developments which create fighting weapons today will tomorrow furnish the power to drive her household forces.

American industry, hankering to build the wonder kitchen and a multitude of other ingenious devices, is no less eager than the enthralled housewife. Although still zealously pouring its energies into busy arsenals, industry is even now surveying postwar horizons, aware of the multiple skills and the sanguine imaginations that will then be needed.

Plastics manufacturers have welcomed both the battle-born developments of its pioneers and those worked out by the newcomers to the industry. Inventive craftsmen responded to plastics with fresh ideas, interpolating techniques which they carried over from other industries. They dared to attempt—and frequently accomplished—the "impossible." In the peace to follow, the plastics industry expects to apply war-tested "know-how" and to reach out to other innovators for creative designs and processes.

The kitchen pictured on the four following pages is presented not as the ultimate blueprint of the housewife's dream room, but as a stimulus to further investigation of the materials described and as a guide to their intelligent application.

A new conception of the kitchen

The science of new materials and modern devices, the coordination of appearance and performance, find no more suitable spot in which to make their debut than the kitchen. Much has been achieved in the past in the way of color, dependability and efficiency. Equipment and appliances have been redesigned to save wearing steps and back bending, labor-saving gadgets have been added and the decoration has been riotous.

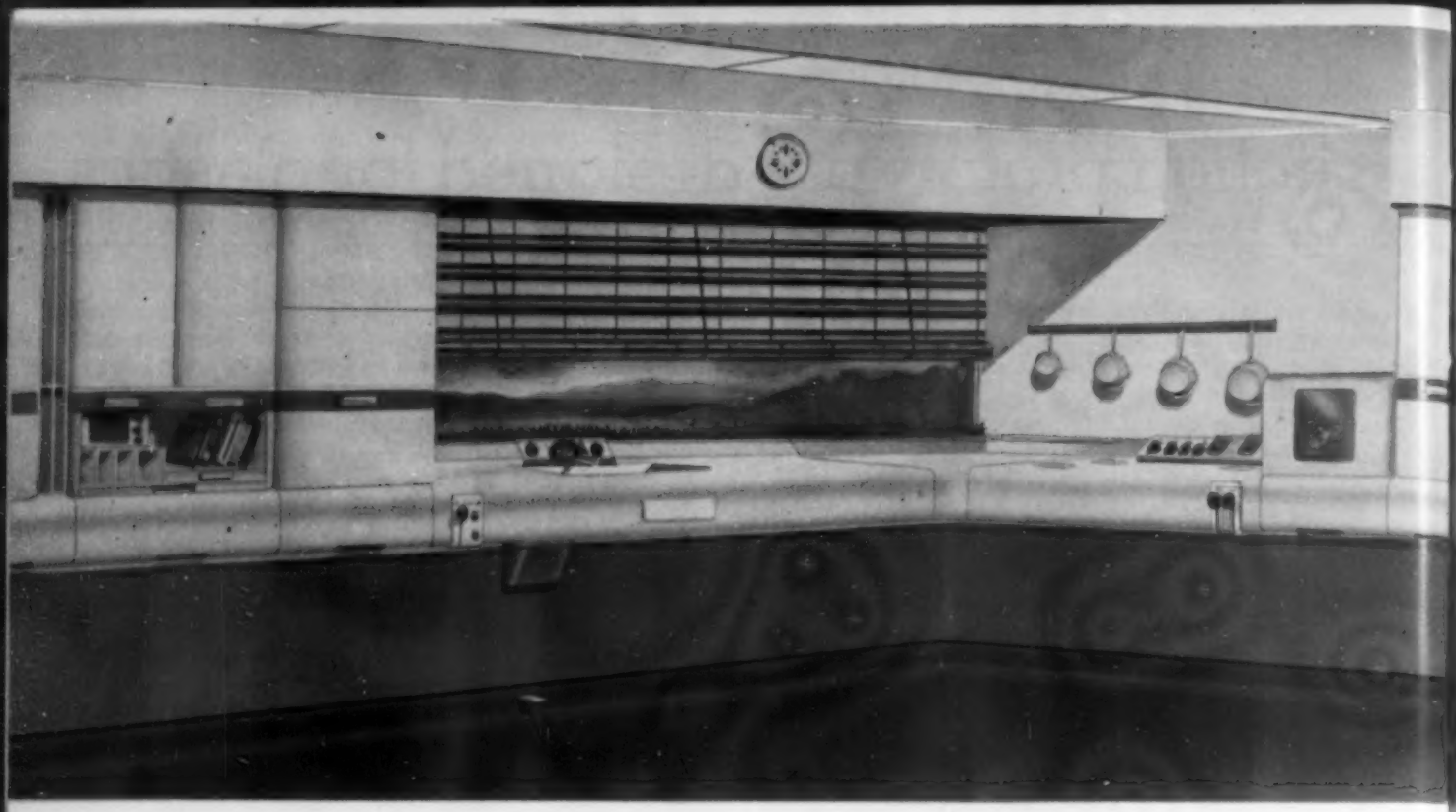
Kitchen redesign has now reached a point where a radical approach is necessary if there are to be further improvements in appearance and utility. The revolutionary achievements in plastics, metals, glass, etc., must be adapted to the demands of the kitchen. Scientific advances such as quick-freezing, and the varied requirements of cooking, cleaning, storage and eating must be coordinated and considered as a single problem requiring a single over-all treatment.

"We suggest," states Peter Müller-Munk, "that the kitchen of tomorrow be designed as a space in which certain definite duties and operations be accomplished—somewhat in the manner of a factory. However, since we are dealing with the home, and not with an industrial plan on rigidly calculated production schedules, our kitchens must maintain those ele-

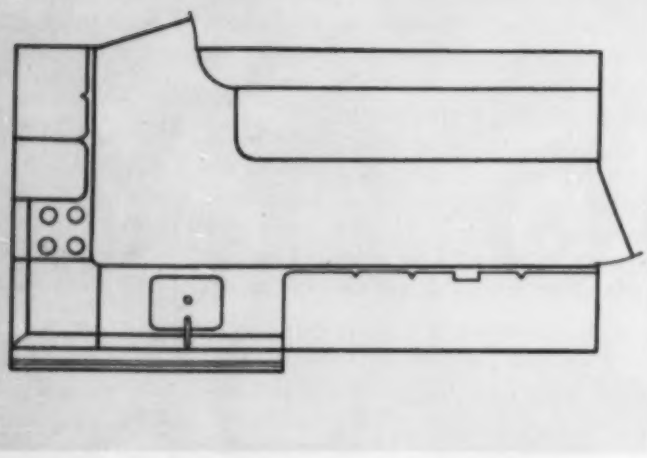
ARMED with a college degree and with the diploma of a silversmith, Peter Müller-Munk came to the United States in 1926 and for several years practiced his trade as one of the leading metal craftsmen. Then fate took a hand. The merchandising department of a large New York department store asked him to design a line of commercial pottery. It was but a small step from this to the creation of more ambitious and complex industrial products. In the course of the next few years, Mr. Müller-Munk designed a great variety of products ranging from compacts and hairbrushes to valves, vending machines and electrical applicances. He experimented with all types of new and old materials for his designs—metals, glass and, to be sure, plastics.

"I learned about plastics," he confides, "by reading gobs of literature, thinking things out on paper, making models and visualizations, and by just hanging around factories and chemists and asking a lot of leading questions. Then, too, I tried to apply my experience and knowledge of other materials and techniques to plastics processes and design.

In 1935 Mr. Müller-Munk joined the faculty of Carnegie Institute of Technology where he helped to organize and teach the first college course in industrial design. He likewise conducted courses in production methods. Since then he has greatly enlarged his consulting practice in the plastics, metals and manufacturing industries. In late years, he has combined this work with the supervision and illustration of technical literature and has been retained for many important commissions by the Armed Forces and industry. As this goes to press, he has just severed his college connections so that he and his office staff can devote themselves entirely to industrial design and war work.



1—The dream kitchen of tomorrow, as envisioned by Peter Müller-Munk, combines factory efficiency with charm of gracious living. Appliances are grouped to save steps, are easily accessible, are harmonious in color and design. The operational half includes storage cabinets, sink, stove, oven and refrigerator. Surfaces are plastic-coated. Fixtures, handles, faucets, control levers and rollblind are designed of plastic, in bright, clean colors



2—Over-all layout as indicated in floor plan. Section at left and bottom is pictured directly above, while area at top of diagram is illustrated on opposite page

ments of charm and livability which make working in them a pleasure rather than a chore.

"The devices essential to the smooth functioning of our meals will no longer be considered as separate appliances distinguished from and sometimes conflicting with the all-over architecture of the room. They will, we believe, be part of the walls, floors or ceiling; their distribution and design will be considered as functioning architectural elements rather than independent units 'attached' to wall or floor. Air-conditioning and lighting, refrigeration and cooking, dish-washing and garbage disposal—these and all the many other necessary requirements will be met in more logical and economical ways than we have thought possible.

"Once the full potentialities of new materials and new production methods are investigated with a fresh eye toward their intelligent application, the entire realm of future planning and production appears in its true scope."

The operational half of the kitchen

Firmly convinced that the postwar housewife, less in awe of mechanical apparatus than was the sheltered homebody of the past, will demand perfection in the machinery of her kitchen, Peter Müller-Munk has designed the working portions of his kitchen for maximum efficiency.

To his point of view, "the woman who has operated a drill press, handled a rivet gun, driven a Red Cross ambulance or taken apart a M-1 rifle while blindfolded will not be frightened by the complexities of mechanical construction. She will, however, insist that her household appliances be as functionally perfect as the tools or weapons she has been handling during the war period and as easy to keep in good repair."

It is not surprising, therefore, that in selecting material and designing the scheme of his kitchen, Mr. Müller-Munk has kept in mind not only the convenience of the housewife but the utility of the instruments she will have to operate. In one half of the kitchen layout—the working side—he has grouped the major appliances involved in the storage, preparation and cooking of foods. These are the refrigerator, sink, oven and garbage disposal units. Traditional multiplicity of sizes and heights has given way to an even, harmonious play of surfaces and shapes. Physical comfort and convenience are stressed—no straining or needless stretching. Everything has its place and is in plain sight. Materials, colors, textures—all are subtly blended with operational requirements. The position of the refrigerator, for example, is considered in relation to the placement of the sink and oven in an effort

to achieve maximum accessibility without adversely affecting the general appearance of the room.

Color, durability and ease of cleaning are imparted to the ceiling and wall coverings of this kitchen by a coating of ethyl cellulose, and the designer claims similar properties for a floor laid with vinylidene chloride sheeting. The two-tone rollblind of extruded ethyl cellulose strips, which are supported by woven vinylidene chloride cords, shades the window that overlooks a garden. Mr. Müller-Munk can see no reason why the housewife should not enjoy the view even while she is washing dishes or cleaning vegetables. For city dwellers the outdoors is brought inside by means of growing plants which are set in window boxes formed of deep-drawn ethyl cellulose sheet.

As a relief from too many smooth surfaces which the designer believes create a monotonous effect, the entire wall area below the cabinets is faced with woven vinylidene chloride cloth—easy to install and available in an almost infinite variety of colors.

The service-dining half of the kitchen

This side of the kitchen (see floor plan) gives an illusion of freedom and space due to the color and variety of the furnishings, accessories, dishes and even of the groceries which are stored in plain sight. Through a clear glass cupboard lined with ethyl cellulose, we can see into the adjoining dining room, and the stainproof ethyl cellulose coated door at the far left connects the two rooms. Glassware and china come out of dark closets to contribute their elegance and sparkle to both kitchen and dining room, and the cupboard itself is so designed that it forms a transparent supporting part of the dividing wall.

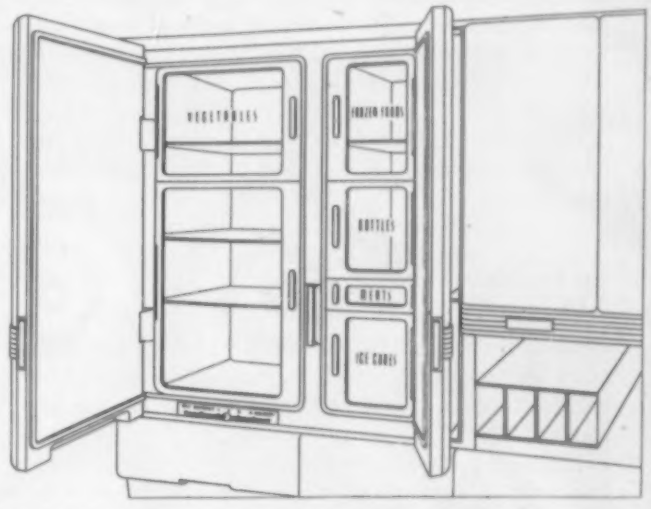
3—*Service and dining half of the kitchen, with sliding table ledge pulled out. Collapsible chairs, upholstered in plaid vinylidene chloride and backed with the same material in solid color to match lower wall covering, fit into recess forming unbroken surface. Cabinets are ventilated with screens of this woven plastic and lined with ethyl cellulose sheeting. Plastic trim is used on edges and on glass and china cupboard at left*

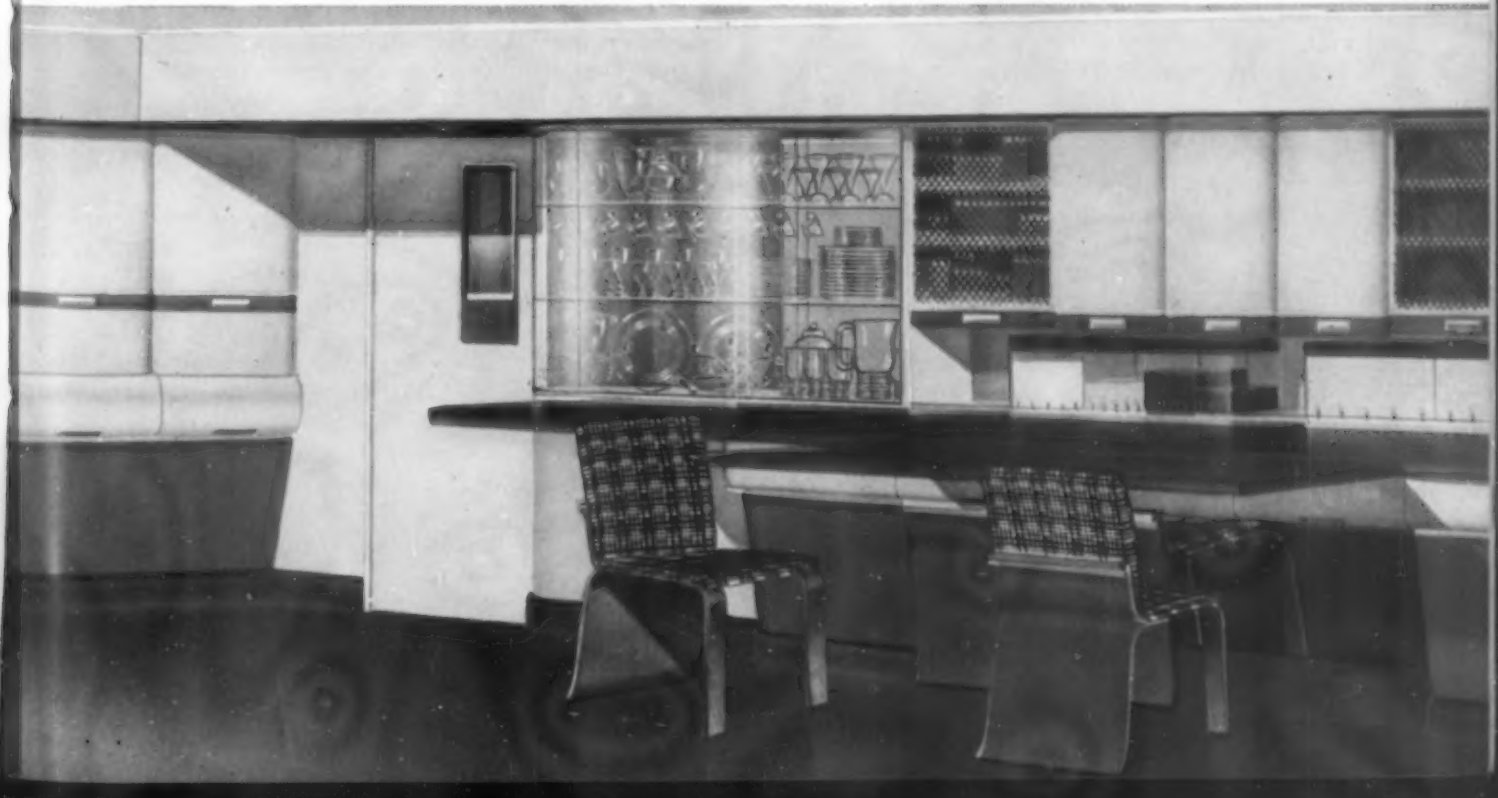
Packaged foods and other groceries in colorful containers are kept free from dust in two other cabinets which are well ventilated by doors screened in woven vinylidene chloride. The insides of these cabinets are faced with long-wearing ethyl cellulose sheeting which may be wiped clean with a damp cloth. With canisters deep drawn of ethyl cellulose sheeting a quick glance is all that is needed to show the housewife the amounts of food such as sugar, rice, coffee, tea etc., that are on hand.

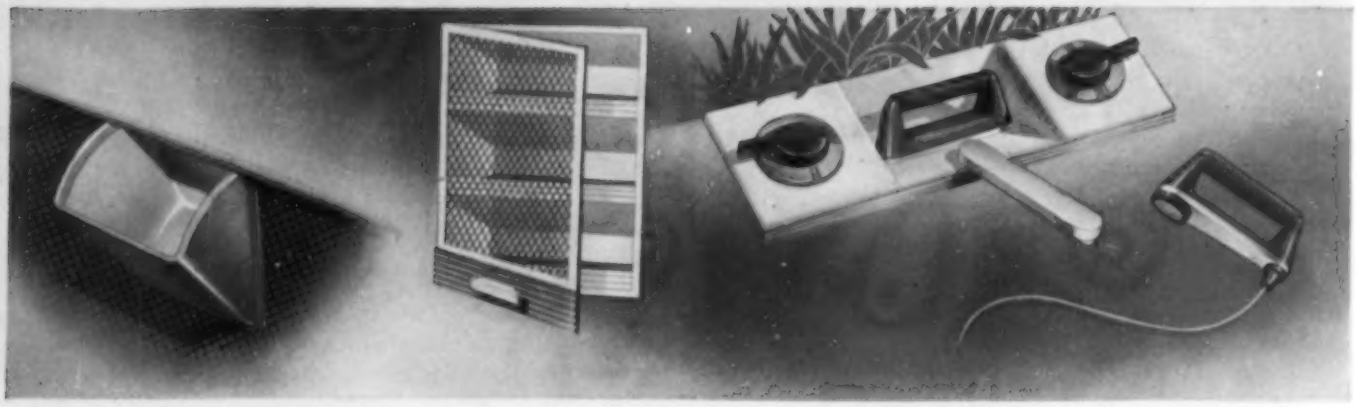
For breakfast in the kitchen or for midnight snacks, Mr. Müller-Munk has a unique solution. A table ledge, which slides into the wall when not in use, can be pulled out to provide ample table surface for four diners. The ethyl cellulose facing on this ledge is permanent in coloring and impervious to stains of foods or liquids. It does away with the need for tablecloths or mats.

All four diners can be seated on collapsible chairs whose hinged backs can be folded down so that the chairs fit snugly

4—*Two-door refrigerator with individual compartments to help maintain temperature. Clear polystyrene doors permit view of contents. Extruded plastic seals doors*







5—Created for convenience are (left) waste receptacles deep drawn from ethyl cellulose sheet which swivel under sink ledge and a storage cabinet (center) surfaced and screened in plastic. Sink unit (right) with molded vinylidene chloride faucets, handles, polystyrene levers and dials, may be operated through selector mechanism or by foot pedal. Spray in center of unit may be pulled out when needed

into a recess under the table, forming an unbroken, continuous decorative surface to match the low wall cabinets in other parts of the room. The seats and backs of these chairs are upholstered in washable, colorfast woven vinylidene chloride fabric. The compact arrangement eliminates any cluttering of the kitchen with excess furniture during working hours but offers opportunity for flexible arrangements when needed.

Added color and protection are provided by extruded ethyl cellulose trim on glass and china cupboards and work surfaces. Even cup hooks are molded of this material.

The refrigerator

The subject of much progressive thinking, the refrigerator of tomorrow will undoubtedly be provided with such new features as quick-freeze and frozen food storage units, and various types of special sections to meet changing food and cooking habits.

Mr. Müller-Munk has recognized some of these innovations in his multiple-compartment refrigerator, which departmentalizes the contents for easy handling. To eliminate loss of refrigeration that results from frequent opening and closing of one large refrigerator door, he has designed his box with five individual compartments which are sealed off from the rest of the box by transparent molded polystyrene doors. Thus, when the outer door is opened, the housewife can see into these compartments without exposing the contents to room atmosphere. This saves current and protects the freshness of the food. Lettering on each door is molded in and color is wiped on the reverse side for greater legibility. The airtight seal on the outer door is formed from two interlocking extruded vinylidene chloride channels, accurate in dimensions and unaffected by low temperatures. The cold-control escutcheon plate and knob are molded of polystyrene.

To overcome the usual awkward struggle with each ice-cube tray, an expanding liner of vinylidene chloride sheeting is suggested. A slight pull on the liner releases the ice cubes. The corrugated sheet can then be fitted back into its drawn ethyl cellulose shell for the next freezing.

Cooking range

Limiting himself to the thermoplastic materials, Mr. Müller-Munk has specified a few conservative but dependable uses for plastics on the kitchen range. Control knobs and dials, the oven-door escutcheon plate and lever knobs are molded of polystyrene. The large housing for all controls, which has two cavities for condiment dispensers, is molded of vinylidene chloride. The salt and pepper shakers which literally fit into their own individual grooves are molded of the

6—Refrigerator components include: molded polystyrene door with letters sprayed on the rear; interlocking extruded vinylidene chloride channeling used as door seal; cold-control escutcheon of clear polystyrene and unique deepdrawn ice tray, featuring corrugated plastic sheet which permits ready removal of cubes

same material. The channels which give opportunities for the display of shining pots and pans are made of extruded ethyl-cellulose strips.

Sink and water control

One-handed regulation of hot- or cold-water control is made possible by the construction of the mechanism so that the housewife can set the desired temperature with the right-hand lever, then operate the "on and off" control with the same hand. Or, should both hands be occupied, she can turn the water on or off using a knee-operated lever below the sink. The faucet housing and dish or vegetable spray handle are molded of vinylidene chloride, while faucet dials and lever employ polystyrene. The knee lever is of ethyl cellulose. The spray, which utilizes extruded tubing and a molded coupling of vinylidene chloride, slips out of sight when it is not being used.

Refuse can and dishwasher

The garbage receptacle is no longer a separate appliance but an integral part of the kitchen architecture. Receptacle bezel and pedal are molded of vinylidene chloride which does not chip and resists food and refuse acids.

Like the garbage receptacle, the dishwasher is hidden in the operating units, only the polystyrene levers, control buttons and escutcheon plate—in colors which blend with the rest of the room—being visible.

Kitchen accessories

The influence of plastics on the smaller devices in the kitchen is nothing new. In addition to the cheery radio, books and other practical accessories not shown, such as coffee makers, orange squeezers, pot handles, clocks, etc., Mr. Müller-Munk suggests a colorful strainer of two-toned woven vinylidene-chloride mesh held firm in matching rim and handle of molded ethyl cellulose. Instead of hiding cutlery in drawers where its sharp cutting edges may be nicked or dulled, he suggests a wall rack of molded ethyl cellulose with niches for each knife and transparent blade guards of polystyrene sheet. Knife handles, of course, are of colored plastic.

And finally, Mr. Müller-Munk binds the cookbook in vinylidene chloride fabric which won't be soiled by wet fingers checking up on favorite recipes—in fact, even the pages may be coated with synthetic resin to provide a water-repellent or waterproof surface!

Although only three main groups of plastic materials have been specified throughout, this kitchen has been planned to take advantage of current improvements in other classes of materials and of advanced thinking along technological and architectural lines. Throughout, the principal motivation has been a desire to suggest good design, economy of manufacture and sound utilization of plastics.

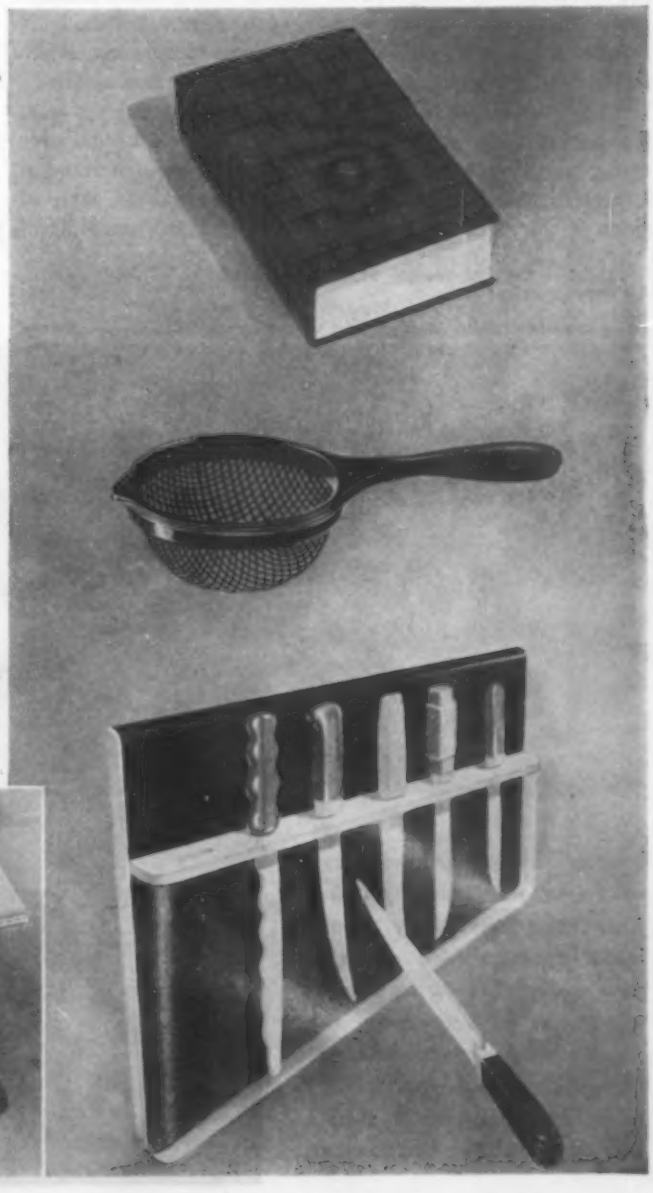
Kitchen specifications

Saran: radio grille, cookbook cover, spray handle, spray tubing, spray tubing connection, rollblind tapes, salt and pepper shakers, garbage receptacle bezel, garbage disposal foot pedal, cabinet door fronts, garbage receptacle, faucet housing, range control housing, under-cabinet facing, chair covering, floor covering.

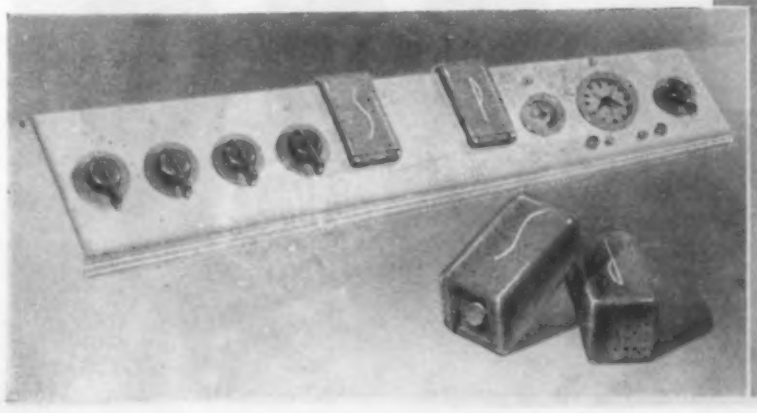
Ethocel: light trough cover, light trough bezel, cabinet knob channels, rollblind, plant containers, pot-holding channel, wall covering, ceiling covering, radio, door covering, knee-operated faucet lever, door push plate and window bezel, work surface trim, hooks for cups, glass and china cupboard trim, cabinet lining, canisters and canister lids.

Styron: radio knobs, dishwasher lever escutcheon plate, faucet dial, faucet lever, clock case, range control dials, range control knobs, trays, cabinet knobs, dishwasher door-opening lever, dishwasher control buttons, oven door-opening levers, oven door-lever escutcheon plate.

***8**—Gay kitchen accessories add color, are practical, too. Cookbook is bound in washable vinylidene chloride fabric and the same material forms the mesh of the molded ethyl cellulose strainer. Plastic-handled cutlery fits into a molded rack, covered by transparent sheet*



***7**—Range control panel of molded vinylidene chloride has niches for contrasting colored condiment shakers of the same material. Knobs and levers are molded polystyrene*



Flame resistant cellulose acetate

by DR. MARIE BENTIVOGLIO and BURTON E. CASH*

A new series of cellulose acetate molding compositions with improved flame resistance has been developed through a combination of formulation and processing technique

FOR some time there has been a limited but persistent demand for a cellulose-derivative molding material having improved flame resistance over that of present cellulosic molding compositions. Previous attempts to achieve this goal have not been successful because they resulted in too great a sacrifice of desirable physical properties, due to breakdown in viscosity of base material at molding temperatures.

A new series of cellulose-acetate molding compositions with improved flame resistance has been developed through a combination of formulation and processing technique.[1] When tested for flammability by A.S.T.M. method D 635–41 T, they are classified as self-extinguishing. In this test, the softer flowing compositions become extinguished immediately after or within a few seconds of the removal of the igniting flame. These compositions do not change materially in physical properties under the heat of injection molding.

The physical properties of the flame-resistant series of cellulose acetate compositions are presented in Table I. An interesting comparison is afforded with the properties of standard Lumarith X cellulose acetate formulae by pairing compositions of the same impact strength. The importance of this property as a measure of toughness of cellulosic plastics has prompted its selection as the basis of comparison. Two such pairs having equal impact strength are included in Table I, namely, Lumarith X-M-H3, CA-Z-13979-H5, Lumarith X-M-H7 and CA-Z-13976-H8.

For formulae of the same impact strength, the compositions of this series have a higher tensile strength than those of the Lumarith X series, by about 20 percent for the hardest flowing material. The same trend is found in flexural strength, which shows an increase of about 10 percent over the standard formulae. Likewise, the deformation under load is about one-half that of any standard materials which have the same impact strength. The flame-resistant series, therefore, offers materials of greater rigidity (as expressed in greater flexural strength and less deformation under load) than standard formulae of comparable impact strength. It should be noted that the range of compositions included in this new series is limited to the four formulae from H5 to H8, and that the impact strength is in line with that of hard formulations.

Of especial interest is the fact that, although these compositions have a high plastic flow temperature as determined by the A.S.T.M. Method D 569–43 on the Tinius-Olsen Flow Tester, they resemble in their injection molding behavior

* Celanese Corp. of America, Plastics Div.

[1] Patents applied for.

PHOTOS, COURTESY CELANESE PLASTICS CORP., DIV. OF CELANESE CORP. OF AMERICA

1—When molded of flame-resistant cellulose acetate, these pressure-tight grommets stand up well when subjected to a direct flame

2—The same characteristics of flame resistance, toughness and resiliency that make parts molded of this new material, such as these grommets, so acceptable to plane manufacturers and ship builders, should find them a ready market with post-war automobile companies

TABLE I.—PHYSICAL PROPERTIES OF THE FLAME-RESISTANT SERIES OF CELLULOSE ACETATE MOLDING MATERIAL AND OF TWO STANDARD FORMULAE

Property	*Unit*	*A.S.T.M. method*	*Conditioning of specimens before testing*				*Lumarith X-M-H3*	*Lumarith CA-Z-13979-H5*[d]	*Lumarith CA-Z-13978-H6*[d]	*Lumarith CA-Z-13977-H7*[d]	*Lumarith CA-Z-13976-H8*[d]	*Lumarith X-M-H7*
			Temp. ° *C.*	° *F.*	*Rel.hum., percent*	*Time*						
Flow temperature	° C.	D 569–43	25	77	0	3 days	161	170	175	180	185	180
	° F.	.....	..	...	..	.....	322	338	347	356	365	356
Specific gravity	Gm./cc.	D 176–42 T	..	...	..	.....	1.280	1.299	1.301	1.304	1.306	1.291
Brinell hardness	Kg./sq. mm.	E 10–27	25	77	50	2 days	8.0	9.6	10.5	11.5	12.5	11.9
Rockwell hardness	R scale	D 229–43	25	77	50	4 days	106	106	112	117	119	122
Impact strength (Izod)	Ft. lb./in. of notch	D 256–43 T	25	77	50	2 days	2.3	2.3	1.9	1.6	1.2	1.2
		D 758–44 T	−40°		..	1 hour	0.6	0.3	0.3	0.3	0.3	0.5
Distortion under heat	° C.	D 648–41 T	25	77	50	3 days	64	59	65	72	80	75
	° F.	.....	..	...	..	.....	147	138	149	162	176	167
Deformation under load at 50° C. (122° F.)	Change in height Percent—24 hr.	D 621–43	25	77	50	3 days	9.4	4.2	3.7	3.0	2.6	4.2
Tensile strength[a]	P.s.i.	D 638–42 T	25	77	50	14 days	5400	5700	6700	7400	8000	6300
Tensile upper yield stress[b]	P.s.i.	D 638–42 T	25	77	50	14 days	4700	5200	6300	7100	7600	6100
Flexural strength	P.s.i.	D 650–42 T	25	77	50	2 days	8200	8600	10,200	11,700	13,100	12,000
Modulus of elasticity in flexure	P.s.i.	D 650–42 T	25	70	50	2 days	2.8	2.7	3.2	3.6	4.0	3.9
Water absorption (wt. gain in 24 hr. immersion plus soluble matter lost)	Percent	D 570–42	50	122	..	1 day	2.2	1.9	2.0	2.1	2.2	2.4
Soluble matter lost	Percent	.....	..	...	..	.....	None	None	None	None	None	None
Weight loss on heating for 72 hr. at 82° C. (180° F.)[c]	Percent	D 706–43 T	25	77	0	2 days	1.2	0.6	0.6	0.5	0.4	0.4

[a] Specimens were previously conditioned for 2 days in a circulating-air oven at 50 ± 2° C. (122 ± 4° F.) and cooled in a desiccator over anhydrous calcium chloride for at least 16 hours.
[b] Specimens machined from compression molded slabs.
[c] Compression molded specimens. All other specimens were injection molded.
[d] These 4 materials are the flame-resistant series of cellulose acetate molding material.

cellulose acetate materials of two to three flow steps softer. Reports from the field have confirmed the laboratory findings that CA-Z-13979-H5 composition has injection-molding temperatures similar to standard materials of an H2 to H3 flow. If a comparison of physical properties is made between formulae of this series and standard compositions of similar injection-molding behavior, the tensile and flexural strength, distortion under heat, and deformation under load figures of the former again show better values.

The fine surface finish of cellulose acetate molding materials is also characteristic of these compositions, and the luster and clarity of pieces molded in light transparent colors compare favorably with the best cellulosic plastics. Crystals and a complete color range are not offered at this time.

Although these compositions are highly resistant to combined high heat and humidity, the softer flowing members do have some tendency toward surface bloom. For example, the exposure of molded pieces for 24 hr. at 100 percent relative humidity and 100° F., followed by 24 hr. at 140° F., as prescribed in the A.S.T.M. Test D 765–44 T, Procedure VI, results in the formation of a surface bloom on the CA-Z-13979-H5 composition during the first half of the test which is reabsorbed during the second half. However, under the less extreme conditions which might be expected in normal service, it is not anticipated that this effect will be noticed.

An examination of the data would indicate that where a greater degree of flame resistance is needed in molded applications, the use of this new series of cellulose acetate compositions should be considered. If this property is not of paramount importance, the selection of this series might well depend upon its inherent rigidity and excellent resistance to deformation. Both the good dry-heat resistance or permanence (as expressed in low weight loss on heating) and the lack of soluble matter lost in the standard water-absorption test (A.S.T.M. Method D 570-42) are characteristics of this series which should add to its serviceability in the field.

New applications which suggested themselves are molded parts for the electrical industry. Here, as elsewhere, the increased resistance to flammability will prove advantageous when seeking the approval of the Underwriters Laboratory.

Blowing full-vision cockpit enclosures

COMPLETE elimination of the "blind" spot in cockpit enclosures—so dreaded by fighter pilots—has been effected by means of a full-vision "bubble" cockpit enclosure developed through a new contour control process. Currently employed on the North American P-51 Mustang, these enclosures represent perhaps the most outstanding development to date in this phase of airplane manufacture. Using an electric oven equipped with temperature controls, pressure gages and switches, the part—already fabricated, cemented and machined—is heated and formed at the same time.

The flat pattern is cut from a $^{1}/_{16}$-in. methyl methacrylate sheet. A hinged templet guides the hand router which cuts the pattern to proper shape, after which the part is machined to the exact shape of a master templet. Then, narrow methacrylate strips, designed to serve as a flange for attaching the finished canopy to the fuselage, are formed to the contour of the flat pattern and cemented to the main sheet. Prior to the cementing operation, the strips are secured in their proper relative position by specially designed jigs, and to insure a perfect cemented joint, are held by 72 toggle clamps.

The flat sheet is placed in an oven where it is heated under careful supervision. When a pliability test indicates that the heated sheet is ready for blowing, it is taken from the oven and carefully laid on the blowing jig.

Through controlled application of positive air pressure during the blowing process, a skilled operator is able to check the part throughout the operation at several control points. By means of pressure gages, timers and cooling control switches mounted on a control panel, temperatures and air pressure are accurately maintained or regulated within the forming "bubble." The desired center line contour is produced and maintained at all points through temperature modulation, pressure control and checking at the various control points.

When the part has been blown to the proper shape, the operator maintains the requisite air pressure through a check valve until the part is chilled.

Credits—Material: Lucite. Blown by the Plastack Contour Control Process by Stack Plastics.

PHOTO, COURTESY STACK PLASTICS

1—Full-vision cockpit enclosures can now be made by a new contour control process which heats and forms the methacrylate sheet simultaneously

COLOR *harmony in the molding shops*

by J. A. MEACHAM*

Planned painting of plant interiors is now being accepted as a means of increasing the productive efficiency of the worker, improving his morale and lowering the accident rate. In this work color plays an important part—as a warning of danger, a stimulus to action in case of emergency, a counterbalance to the glare of artificial lights and an outlet for the workers' individuality. There are three general systems of plant painting. According to the requirements of special sections of a plant, the color scheme and the system of painting can be varied—endlessly.

FROM an industry-wide point of view, the plastics molding shop offers a most fertile field for a modern industrial painting job. Of all the hundreds of molders in the country, scarcely a dozen have taken steps to increase the productive efficiency of their workers, to improve morale and to lower the accident rate by making use of recent advancements in industrial painting techniques.

The lighting in molding shops as a whole has been improved in recent years, but this lighting has often been lost—absorbed that is—by dingy walls, machines and floors. It seems timely, therefore, to present to the plastics industry a brief analysis of the modern industrial painting field, along with the latest developments. The far-seeing molder will be quick to perceive the many advantages to be derived from a modern color harmony program, some of which we will try to cover here.

Industrial painting schemes are not new. In 1919, in a colorful burst of enthusiasm for the idea, one large company painted the full lengths of all pipes in its factory with identifying colors. The result was a riot of colors going everywhere, which was a far cry from today's efficient, restful color schemes.

There are still a variety of opinions as to what constitutes proper industrial painting. One school of thought considers the use of a cool green throughout as the ideal, because this color has a relaxing effect similar to that of the green found in nature. The drawback to this plan is that it does not take individual preference into consideration. Another school which considers production efficiency to the exclusion of all else, advocates an unequivocal gray and ivory combination for best results. Still a third group, on the other hand, offers a selection of 17 complementary color harmonies, worked out to suit the tastes of individuals in different kinds of plants.

Four points of caution

There are certain mistakes made in industrial painting and it is well to review some of these, since they bring up a number of good points relative to the sound planning of this particular type of work.

First, it is well to avoid a riot of color. Too many colors are distracting. Pipes should be identified by color bands at valves, unions and couplings, and otherwise be painted the same as the wall. This plan eliminates the resetting of scaffolding at the time of painting, and facilitates the job by permitting the sprayer to work faster, unhampered by the need for avoiding piping or protecting it from the wall paint. It also makes for apparent increase in the size of the room, as pipes are unsightly at best and, if blended with the wall or ceiling, do not tend to decrease the psychological ceiling.

A definite color code has been set up by the American Society of Engineers in collaboration with the American Standards Association. But pipes should be banded according to this code, not painted in full length, for best results. The Standard Color Code can be interpreted as follows:

Red—Sprinkler system, control valve, extinguishers, etc.
Yellow—High-pressure steam. Low-pressure steam and heating steam is usually identified by the white wrapping.
Green—Cold water or "safe" lines.
Blue—Air lines.
Brown—Gas lines.
Orange—Caustic and acids.
Purple—Used where material of extreme value is piped.
Aluminum—Used on hot water lines as it resists discoloring due to heat.

Second, use red sparingly. Use it only for sprinkler heads, the main sprinkler valve (so it may be quickly located and turned off after a fire to prevent water damage) and to identify the location of fire extinguishers. Red should stimulate impulsive action in emergencies. It should not, for example, be used on mere machine handles which an operator uses all the time. Use a high-visibility yellow, not red, for danger areas, where there is danger to personnel, etc. Parts of machines normally provided with covers or guards may be painted in contrasting colors to accentuate the absence of the cover and prompt its reinstallation. The inside of electric control boxes may also be painted to facilitate visibility and speed servicing.

Third, use accent colors sparingly. Do not use danger colors unless a definite danger exists. Otherwise the value of the color accent will be lost through too frequent repetitions and its attention value will decline to the point where it merely provides a distraction. In addition too many color accents give a choppy, restless impression.

Fourth, do not count on better lighting and modern fixtures alone to improve worker efficiency, because stronger light sources may actually produce a harmful glare. Glare is caused when a strong light source against a dark background competes for the attention of the eye, as in the case of an unshielded light fixture seen against a grimy wall. Paint is needed to build up the reflective power of the background and so reduce the contrast between the light source and the background wall or ceiling which causes glare. A white ceiling itself becomes a large-area source of glare-free light when indirect light is used. The unit light of the fluorescent tube is lower than that of an incandescent bulb, and in consequence indirect lighting is not generally needed with this type of light. However, even with the fluorescent light, a proper background is required to prevent glare by contrast. Today special blues and greens are recommended for use with this type of light as their colors are less likely to be distorted under the distinctive colors emitted by the fluorescent tube.

Relationship of light and paint

The effect of glare on production may be further pointed up by reference to the common fallacy that eyestrain in a movie is caused by the flicker. Authorities attribute the strain and discomfort to another cause, namely, the excessive

* Manager, Maintenance Sales Dept., Sherwin-Williams Co.

brightness caused by the contrast between the screen and its surroundings. The eye has an automatically controlled aperture, which tries to adjust itself to the bright screen as well as to the dark area surrounding it, a thing it obviously cannot do. This results in a cumulative nervous strain. However, since a high factor of attention is not required, the situation is not serious. But in the case of a man engaged in really critical work—such as at a press—the story is entirely different, for his full attention is required for best production. He may, for example, work in a relatively brightly lighted area while the balance of unconsciously seen background is in near-darkness due to soiled or dingy paint. The iris of his eye is constantly focusing to whatever light conditions it encounters. If they are too extreme, a measurable fatigue results. Therefore, for best production efficiency both walls and machine must be painted to eliminate glare by minimizing visual contrasts.

It is well known to industrial engineers that if a man can do a certain job in a given time with an illumination of, say, 15 foot-candles—a medium normal light—he will do it better and faster at 20, and still better at 50 foot-candles. This improvement, of course, is not indefinite, for a limit is approached where other factors intervene. But today, efficiency experts are talking in terms of 20–30 foot-candles for purposes of general illumination, and 100–250 foot-candles for specific tasks. Without proper painting, planned by experts in industrial colors, it is difficult if not impossible to achieve the efficient lighting which is coming to be recognized as commensurate with efficient production. While paint is not a substitute for good light, it does allow efficient use to be made of available light.

But by and large the plastics industry still has a long way to go before any really efficient figures can be mentioned in discussing its plant illumination. It is very likely that a comprehensive survey would show that only 25 to 30 percent of the available light reaches the working level, and that the light utilization coefficient is under 30 percent. This is almost certainly true of most molding rooms, and probably true of the average inspection, assembly and packing rooms in the plastics industry. The average injection machine or compression press would undoubtedly be found to absorb 90 to 94 percent of the illumination turned upon it, reflecting only 6 to 10 percent, again by contrast causing glare and worker fatigue.

A factor in labor-management relations

Today labor-management experts know that worker fatigue brings about restlessness, discontent, strikes and other expressions of individual maladjustment in the work environment. They also know that some change or novelty must periodically be introduced among workers as a distraction to dissipate the normal human "static" which accumulates in the personal relationships in the social organization of every plant. Painting interiors of molding rooms and inspection and assembly rooms according to the tastes of the people who have to work in them is one way of eliminating the basic eye fatigue which, when it is expressed in labor problems, is seldom traced back to the need for a coat of paint.

An industrial color harmony program, therefore, is of interest to every molder for a variety of reasons. The prime reason for calling in an industrial paint expert, however, is to increase production by keeping the brightness ratio of the work and the surrounding objects within the proper limits.[1] By providing sufficient light-reflecting surfaces so that full use of available illumination is made, maximum worker efficiency is maintained throughout the full shift with a minimum of cumulative fatigues. Sustained production also depends upon atmosphere as well as light. Color gives atmosphere and provides a boost in morale, as it tends to normalize the strangeness of the work environment. It also gives the worker a chance to express himself for a change, instead of continually being acted upon by the management. Today it is known that any action by management tends to result in a desire in the worker to create some type of corresponding reaction. Allowing the worker to express himself by selecting the color of his press room, his injection machines or inspection benches may provide him with a work environment of his own choosing.

Color painting is a definite contributor to the safety factor. Its use builds up emotional associations with molding plant facilities which tend both to promote safety and to increase production. Color painting also tends to promote good housekeeping because dirty machines are conspicuous, and the worker will try harder to keep his machine clean if it obviously needs attention. The machine manufacturers plainly cannot paint each machine to everybody's taste.

Three general systems of painting

The general problem of over-all plant painting divides itself into three general systems.

1. The first or graded-upward system will use, as an example, a neutral gray floor, a dark green dado, an upper wall of light green and a white ceiling. Such a combination could be used to advantage in a press room. The presses would then be a medium green with accent colors of red and yellow with yellow zone marks.[2]

2. The lifted-ceiling system involves the use of a light blue or green ceiling, and white or ivory walls without dado. Here plenty of outside light must be available. Well-lighted trimming and finishing rooms could use this type of painting.

3. The color-band or terrace system of painting is used where high ceilings with ample window openings are found. The ceiling may be white or ivory. A light tint is used above the windows, and the same tint or a dado enamel below. Pillars or pilasters between the windows are white, providing a band of white around the room at window level. A dado color band can be used across the top of pilasters, or along the base of the wall, if desired. This type of painting would be ideal for a plastics plant located in a multi-storied downtown type of building.

It is observed that modern colors in industrial painting tend toward the pastel shades instead of the heavier colors often associated from long habit with machines and industry. Nor is one color scheme followed throughout an entire plant, for the dados, machines and walls can be made to blend from one room to another by making gradual or step changes in the choice of color from one part of the plant to another.

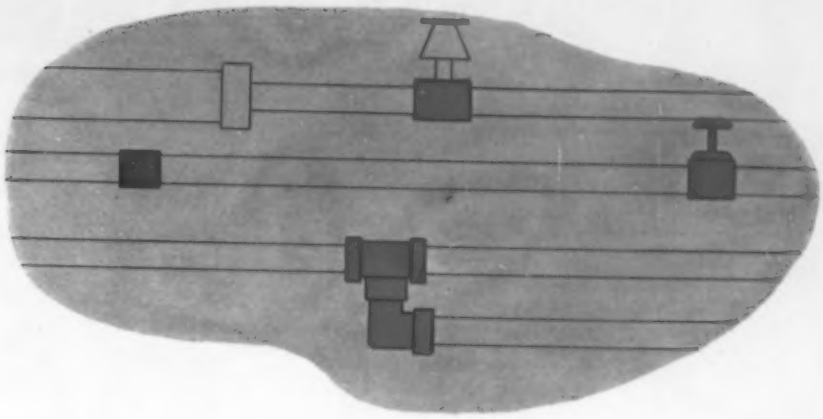
The fact that a very wide choice of color harmonies is now available allows each plant and its personnel to adapt individual systems of painting most suited to their particular environments and personalities and products.

The three steps to modern efficiency are to provide a clean and orderly plant, a well-lighted one and a skilfully painted one. With these simple changes it is now possible to derive the maximum worker benefits from the orderly and well-lighted environment.

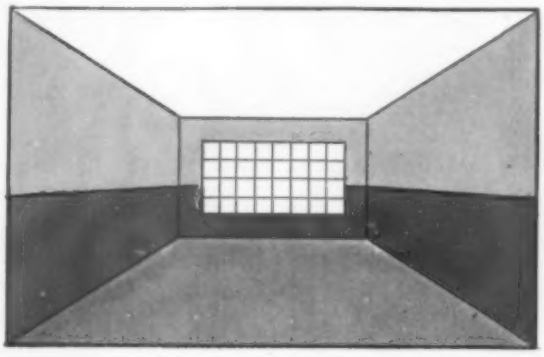
[1] Matthew Luckiesh of General Electric Co.'s Nela Park has shown that when the brightness of the surrounding area is 5 times greater than that of the work, visual accuracy is reduced to 44 percent of normal. If the surroundings are only one-fifth as bright as the work, as in the molding room, a loss of visual accuracy is also experienced up to 77 percent of normal. This can be translated into terms of mold damage due to misplaced inserts, piece spoilage due to unseen remnants of flash, etc., especially on long shifts.

[2] This is but one combination of colors in color harmony No. 8 of the seventeen Sherwin-Williams color harmonies. With minor variations in accent colors, the machines in this group may also be painted silver-gray, brown or beige, and still be in blended harmony with the room.

Pipes should be identified by color bands at valves, unions and couplings. Otherwise they should be painted the same color as the wall

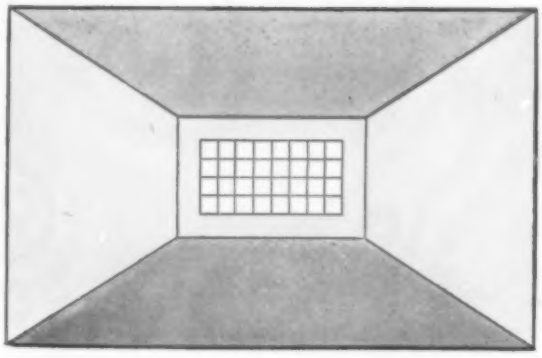


THREE GENERAL SYSTEMS OF PAINTING



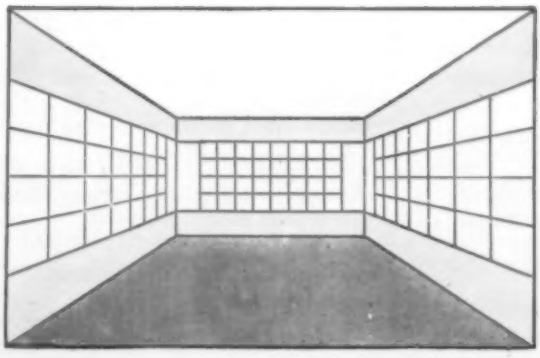
Graded upward system

White ceiling
Light green upper wall
Dark green dado
Neutral gray floor



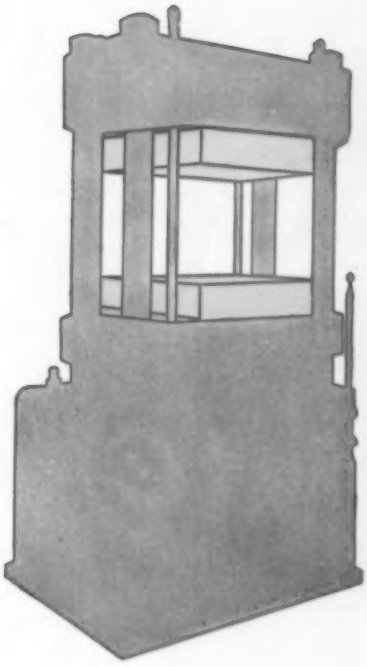
Lifted ceiling system

Light blue or pale green ceiling
White or ivory tinted walls, without a dado



Color-band or terrace system

Ceiling ivory or white
Tint above or below the windows



Use a high-visibility yellow for danger areas on machinery, danger to personnel, etc. NOT RED

LEOMINSTER—CITY OF PLASTICS

MOLDERS AND FABRICATORS

19. Arrow Novelty Co.
4. C. E. Buckley Co.
19. Castle Novelty Co.
26. Commonwealth Plastic Co.
28. Diadem, Inc.
32. E. I. du Pont de Nemours & Co., Inc.
35. Foster-Grant Co., Inc. (Lancaster St. plant)
3. Foster-Grant Co., Inc. (main plant)
31. Great American Plastics Co. (Pond St. plant)
15. Great American Plastics Co. (Spruce St. plant)
33. E. B. Kingman Co.
27. New England Novelty Co.
17. Haldie Nicholson Co.
30. Plastic Turning Co., Inc.
24. Standard Pyroxoloid Corp. (main plant)
34. Standard Pyroxoloid Corp. (Nile St. plant)
12. Star Manufacturing Co.
18. Superior Comb Co.
19. Tata Button Works
11. Tilton & Cook Co.
13. United Comb & Novelty Co.
14. Victory Button Co., Inc.

MACHINE TOOL AND DIE MANUFACTURERS

16. Barker-Davis Machine Co.
1. Central Tool & Die Co.
29. Cote & Lambert Tool Co.
25. General Tool Co.
9. Guy P. Harvey & Son
6. Leominster Tool Co., Inc.
10 Modern Tool & Die Co., Inc.
2. Plastic Tool & Die Co.
7. Standard Tool Co.

REPRESENTATIVES OF MATERIALS COMPANIES

21. Celanese Plastics Corp. (local office)
32. E. I. du Pont de Nemours & Co., Inc.
8. A. F. Perry (representative Nixon Nitration Works)
22. Tennessee Eastman Corp. (local office)

OTHER COOPERATORS

20. Leominster Chamber of Commerce (offices)
5. Saxton Trade School
23. School Department offices (meeting place of School Committee)

Training technicians —a study in cooperative action

The tradition of the town is still strong in New England, even in communities where mayor and council have replaced the town meeting

LEOMINSTER, in Worcester County, Massachusetts, lies along the Nashua River 45 miles northwest of Boston. In 1940 it celebrated the 200th anniversary of its incorporation as a town.

Its industrial growth was much like that of other New England towns whose roots go down into Colonial soil. A saw mill was built to furnish lumber for the settlers' houses. Leather and textile mills arose to provide their shoes and clothing. In time, paper mills grew up beside the river.

Then, in 1774, Leominster took the turning that was to set it apart from its neighbors and give it a distinct flavor of its own. Obadiah Hills, in the kitchen of his home on Pleasant Street, began to carve combs of horn. The chronicle has it that he traveled on horseback twenty miles to Worcester to sell his combs, bringing back in his saddlebags the horn for the next consignment. Soon others were making combs, and their workshops began to scatter along the banks of the Monoosnock Brook where it wound through the town. When in the 1870's John Wesley Hyatt developed pyroxylin, the combmakers adopted this new material. Leominster came to be known as the Comb Town of America.

The community grew and flourished. Like other towns, it felt the impact of the nation's wars, its economic depressions; and like others it recovered and pushed ahead. In 1873 a disastrous fire destroyed eight of its business establishments with a loss of $100,000—a large figure for those days. But nothing so affected the town's industrial life as did the caprice of a woman who very likely had never heard of Leominster.

Irene Castle bobbed her hair!

The fashion spread. All over America scissors snipped, and the side combs, back combs, barrettes and other hair confiners which had weighted women's heads and brought prosperity to Leominster disappeared, together with the rats, switches, puffs, nets and assorted hairpins without which no lady was properly coiffed. Leominster's leading industry suffered a severe setback, and the economic difficulties of the '30's intensified the hardship.

Though in 1915 Leominster had been chartered as a city, the Yankee resourcefulness which was the hallmark of the New England town inspired the combmakers to search for other products which they could manufacture in their plants. They found lots of them—buttons, spectacle frames, toothbrushes, toys, costume jewelry, kitchen utensils—all the volume and variety of plastic articles that were annually shipped from Leominster until the war turned molders and fabricators to grimmer enterprises.

Today there are 23 plants in Leominster engaged in molding and fabricating plastics materials. Nine makers of machine tools and dies used in the processing of plastics have establishments there. Four of the large materials manufacturers maintain offices in the city and one of them, the du Pont Co., has acquired a large local plant. Leominster is a City of Plastics.

In Colonial times one of the most homogeneous sections of America, New England today is one of the most cosmopolitan

Like other New England towns of the pre-Revolutionary period, Leominster was settled by emigrants from the British Isles. Rodgers, Drake, Carter, Chapman, Gardner, Kendall, Whitney, were the names of her early tradesmen, craftsmen, teachers and preachers. As the town's boundaries pushed out from the Common and new enterprises were established, Americans of French, Irish and Italian descent came to Leominster, where they found homes and work and settled down to become members of the community.

Today Leominster has 23,000 inhabitants, over 6500 of whom are employed in its industries. Last year's factory payroll was more than $9,000,000. Of the city's industrial make-up, 80 percent is contributed by plastics.

The public school system is a natural outgrowth of the New Englander's interest in the welfare of his community

In 1741, the year after Leominster was incorporated, the town meeting voted that £10 should be given for schooling the boys and girls of the village, and a committee was appointed to find "sum meet person" to teach them to "read, right and sifer." The first schoolhouse was built two years later.

Today Leominster has eight elementary schools, two parochial schools, a junior and a senior high school, the latter with an enrollment of 681 students. It also has a trade school.

As befits a State with large industrial interests, Massachusetts in 1894 made manual training a part of the school curriculum of all municipalities with populations of 20,000 or more. The textile cities—Fall River, Lowell, New Bedford—have established schools where prospective workers in their mills are trained. In 1917 the Smith-Hughes Act, a national law fostering and aiding vocational education, was passed, according to which financial aid is granted to public schools offering approved vocational courses of less than college grade in agriculture, home economics, trade and industry to pupils of 14 years of age and over.

Leominster's trade school was established in 1920 and was at first called the Continuation School. Boys and girls between the ages of 14 and 16 who were employed attended it on a part-time basis. In 1934, as the Vocational School, it offered full-time courses in machine shop, carpentry, cabinet making, power engineering, building maintenance, sewing, cooking, power stitching and practical plastics, with additional instruction in photography, music, aviation and handicrafts. There is a possibility that it may in time develop into a technical school. The school today is housed in two buildings given by the late Edward H. Saxton, a citizen of Leominster. Two hundred pupils are presently enrolled and there is accommodation for 150 more.

The town organization, the amalgamation of diverse national strains and the public school system have their roots in New England's most pronounced characteristic—the capacity for cooperative action

In Leominster, City of Plastics, the Chamber of Commerce, the School Committee and the plastics industry have instituted a joint enterprise—the training of plastics technicians. Until the plastics course was offered last fall, students in the Senior High School could elect one of three courses: the classical, which prepares for college; the commercial; and the general which, as its name implies, is intended to give the pupil a comprehensive secondary education and not to fit him for any specific career. Thus the boy or girl who was not

financially able to go on to college and who was not interested in commercial subjects had no alternative but to take the general course or to enroll in the trade school.

Many of these young people had ambitions and mental aptitudes which could not be given sufficient scope by the manual-training program of the Saxton School. What could Leominster, as a community, do for these boys and girls?

The answer was provided by the plastics industry, in consultation with Superintendent of Schools William B. Appleton and Rodney F. Poland, Director of the Saxton Trade School, and with the Chamber of Commerce, whose president, John A. Kavanagh of Standard Tool Co., also represents the plastics side of the triangle. It was decided to offer to high-school students a three-year course in plastics which would fit its graduates to qualify as plastics technicians. As such they would without further training be ready to take positions in the plastics plants ordinarily open only to skilled personnel.

Interest in the project was immediate. Mayor Mathias P. LaPierre gave it his blessing. The School Committee appointed Claude A. Letarte, of Plastic Turning Co., and William Hunt, of Cluett Peabody & Co., Inc., to work with the Chamber of Commerce's Plastics Committee. The latter, under the chairmanship of its president, was organized to include the Chamber's secretary, R. S. Appleton, and the following seven representatives of the plastics industry:

G. H. Cook, Jr.—Tilton & Cook Co.
J. C. Foster—Foster-Grant Co., Inc.
R. S. Gavitt—Celanese Plastics Corp.
T. C. Howe—E. B. Kingman Co.
W. H. Lane—Standard Pyroxoloid Corp.
L. Levine—Commonwealth Plastic Co.
A. F. Perry—Nixon Nitration Works.

According to Massachusetts law, students may attend schools in neighboring towns when these offer courses of training not given in their local schools. In such cases the cost of tuition and transportation is borne by the State Department of Education. Consequently the technical plastics course will be available to boys and girls who are not residents of Leominster. Veterans who had not finished high school when they entered the Armed Services will also be eligible.

These students of plastics theory and practice are regularly enrolled in the high school and attend classes there in such subjects as English, mathematics, chemistry, physics. Their plastics courses are given at the trade school, where laboratory and shop equipment are now in process of installation. At the end of the three years they receive high-school diplomas. The first group to take the technical plastics course, 40 in number, will be graduated in 1948, and it is hoped that a one-year postgraduate course can be added.

An ambitious program has been laid out for these boys and girls who plan to enter the plastics industry. They will learn the production of commercial plastics from the point where they are little more than ideas in their designers' minds to the final clang of the cash register that rings up their sale. Specifically, the course includes such subjects as the following:

1. Plastic materials—their properties and applications
2. Product design including drafting and blueprinting
3. Construction of the models from which the practicality of manufactured parts is studied
4. Design and construction of tools and dies
5. Storage and handling of raw materials
6. Preforming and preheating
7. Molding by injection (and, eventually, by compression, extrusion and impression)
8. Fabricating of sheet, rod and tool stock
9. Finishing methods
10. Packing and shipping
11. Merchandising of plastics products
12. Cost accounting for plastics plants

Knowledge of plastics is acquired through three media: textbooks and classroom work; the laboratory and drafting room; and the shop. In the latter, students work with the tools of their trade, learning to operate molding, fabricating and finishing machinery under the direction of teachers drawn from the industry itself.

The plastics companies of Leominster have agreed to supply the raw materials—molding compound and fabricating stock—with which the pupils work, and to furnish classroom lecturers on specialized subjects from among their personnel. The Chamber of Commerce, under the direction of Executive Secretary Appleton, will find markets for small production runs which students will undertake as they gain proficiency in their work. One such project has been planned for the second-year class—a front plate for automobiles to be designed, molded, finished and painted by the students.

Today as yesterday, New England meets with energy and resourcefulness the social and economic problems arising from the concentration of population in her industrial towns

Because it is still in its first year, the Leominster plastics plan must be viewed as an experiment, although it is difficult to see how it can fail of its purpose to serve the young people of the city, the plastics companies, the school system and the interests of the entire community.

To the plastics plants, the advantage of having a supply of well-trained workers locally available is obvious. The time taken and expense incurred in the training of personnel is proportionally greater in a new industry like plastics, which has no appreciable pool of skilled workers to draw upon. Although graduates of the technical plastics course will be under no obligation to enter local establishments, the plastics men hope, naturally, that they will elect to do so.

The School Committee's interest in giving each Leominster boy and girl the type of training that will best fit him for the future has understandably made it a supporter of the plan. Members of the Committee hope that many a young person who might be tempted by the high industrial wages prevalent today to leave school before he completes his high-school training will be persuaded to take the plastics course. To this end, meetings have been arranged with students in the junior high school to explain the technical course to them.

The young people of Leominster who elect to take the course are given an opportunity open to none of their contemporaries in cities of comparable size. The technical training they will receive is analogous, in the plastics field, to that of an engineer in the fields of mechanics, mining, electricity or aeronautics. Comparable, that is, in all respects save one: it will cost them nothing. And upon graduation, they are assured of well-paid positions, some of them on a par with those open to graduates of the leading technical schools and colleges.

Sponsorship of the plastics course by the Chamber of Commerce is evidence of its conviction that this joint enterprise will promote the growth, prosperity and welfare of the city. Leominster, the Chamber argues, can consolidate its position as a plastics center by awakening among its young people an intelligent interest in the industry that has grown up with the town. New plastics plants will be encouraged to locate in a community where they will find young technicians trained in the most up-to-date plastics techniques. Leominster, City of Plastics, will be a better place in which to live, to work and to prosper.

Acrylic cap advances medical science

The basic effects underlying death from shock and head wounds on the battlefield have until recently eluded medical science. However, a step toward the prevention of such deaths has been effected through the development of methyl methacrylate plates which, applied to the heads of live monkeys, permit direct observation of the reaction of their living brains to such effects. In the application of these caps, a Y-shaped incision is made in a monkey's skull, the muscles laid back and two sections of bone removed. After an impression of the prepared head has been made, a working model is constructed from dental stone which is then covered with wax. When a mold has been prepared by sinking this model cap in a mixture of dental stone and plaster of Paris, the wax is melted from the stone model and replaced by methyl methacrylate. Upon removal from the mold the cap is affixed to the monkey's skull with 4 screws. By means of this cap, the effects of high and low pressures, oxygen poisoning, pressure breathing and drugs can also be studied.

NAVY medical men at Bethesda, Md., utilizing methyl methacrylate plates for direct observation of the living brain of monkeys, have added another page to medical knowledge that may some day prevent death from shock and head wounds on the battlefront.

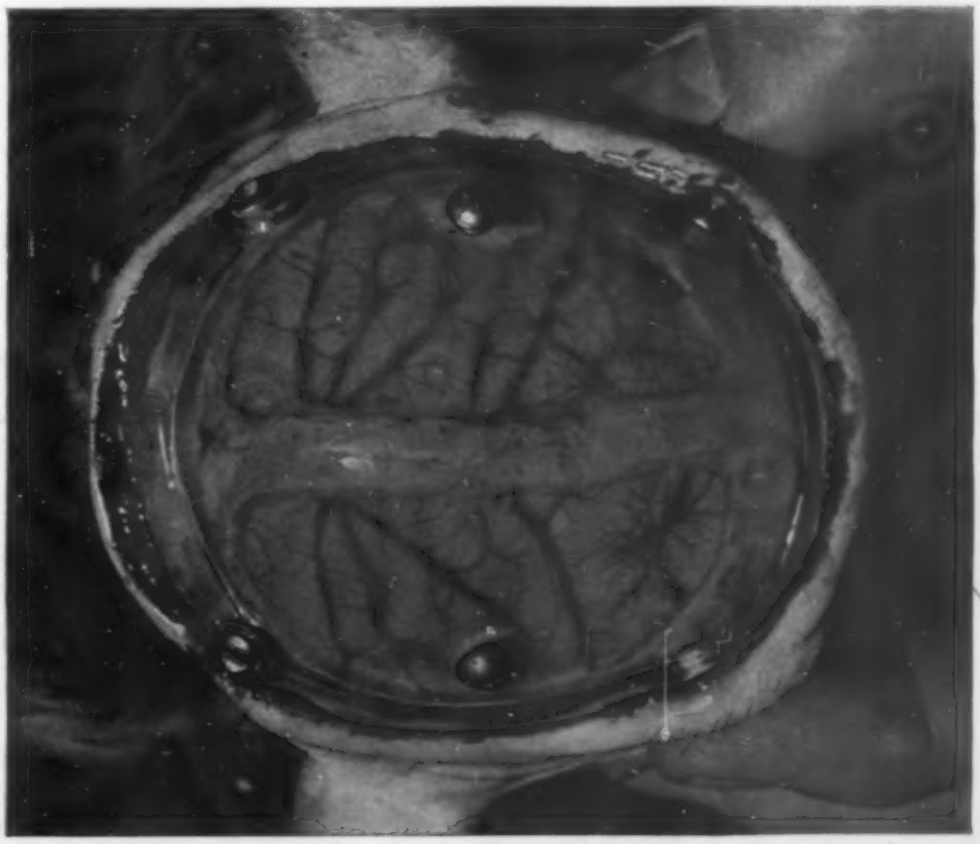
While the age-old dangers to war wounded of death from infection and hemorrhage have for the most part been conquered through use of plasma, sulfa and penicillin drugs as well as by speedy removal from the front lines in jeep and plane ambulances, shock still remains a mystery. In shock the liquid part of the blood pours through the capillary walls into the body tissue. Two actual descriptions of shock at the battlefront give some idea as to its deadly effect.

John Hersey noted in his "In the Valley," a graphic story of Guadalcanal, that battle casualties staggered into aid stations with no open wounds, no blood. Men fell to the ground groaning and holding their sides. They were shock and blast victims! Again, from the pages of a Bougainville doctor: "The night was very dark on this lonely outpost when a Jap shell exploded near an American sergeant's gun position. Multiple wounds and severe hemorrhage were the result. Removed to a battalion aid station, medical officers worked feverishly, confronted with the soldier's marked weakening of pulse. Plasma, as well as other available medical aids, were administered. 'Why can't I see?' the patient asked. His circulatory failure did not provide enough blood for the brain to support vision. The sergeant died of shock."

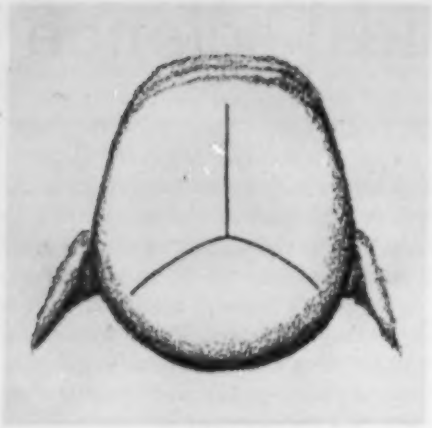
Although very little is heard of head wounds in battle, as they often result in outright death in the field, such wounds account for a large proportion of battle casualties. According to U. S. Army Medical Corps figures in the Italian Campaign (September 1943 to February 1944), head wounds accounted for 13 percent of the wounded. In the Bougainville campaign (February 14, 1944, to April 1, 1944) head wounds chalked up an even greater toll with 21 percent being so classified.

Now plastics have again come to the rescue of man. Through use of methyl methacrylate skull windows, the first successful technique for direct observation of a living brain has been developed by Naval medical men (Capt. Winchell McK. Craig, Lt. Comdr. Joseph S. Restarski, Lieut. C.

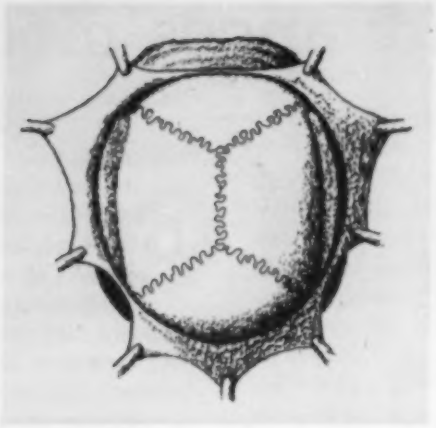
COLOR PLATES, COURTESY JOURNAL OF NEUROSURGERY



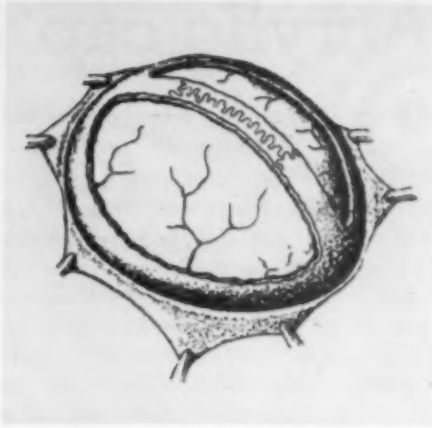
1—*Brain disturbances associated with injuries to the head can now be studied through the medium of transparent methyl methacrylate windows attached to the skulls of monkeys. In this color photograph, a characteristic view of the animal's brain is seen through the plastic cap*



2—*Before a transparent cap can be prepared and affixed to the skull of the monkey, a Y-shaped incision must be made in the top of the animal's head*



3—*Following the making of this incision, the muscles of the head are carefully laid back, exposing the convex surface of the monkey's skull*



4—*Two sections of bone are then removed. A strip of bone is left across the top of the skull to maintain fixation of the longitudinal sinus*

Hunter Shelden and Lieut. Robert H. Pudenz) working at the Naval Medical Center's skyscraper in suburban Washington. For obvious reasons such direct observations have been made on animals. Monkeys have proved most suitable and have shown no bad effects from the experiments. By means of a cranial window molded of methyl methacrylate, it is possible to study brain disturbances associated with blows on the head. These changes are permanently recorded through high-speed motion pictures of the experiments. In addition, exposure to high and low pressures, oxygen poisoning, pressure breathing and administration of drugs have been studied in this manner.

Although direct brain observation through a cranial window is not new, original experiments performed by Ravina in 1811 provided temporary arrangements only and it was not until the advent of plastics that a satisfactory permanent observation technique was perfected. In the original experiments pulsation of the brain was observed by means of fixing one end of a hollow wooden tube in a dog's skull while the other was closed by a watch glass. Later, in 1850, Donders cemented glass squares in animal skulls with rubber and collodion. Too tight a seal prevented brain pulsation and spoiled the experiment.

These glass windows were improved upon by Leyden who screwed steel-framed glass windows into the skull. A small petcock introduced into the window allowed insertion and withdrawal of air and fluids. Leyden's studies of pain, pressure of local and general types on the brain, and brain pulsation, although lost for a time, have now been recovered and are considered a highly acceptable contribution to modern medical science.

It was not until 1928, however, that permanent windows of methyl methacrylate disks were made by Sohler, Lothrop and Forbes. These small transparent windows were screwed into the skull by means of threaded, beveled edges. Again two small holes were introduced for insertion and removal of fluids and gases. The highly polished methyl methacrylate surface enabled direct observation of the brain to be made with a microscope. A great disadvantage in this process, however, was the small diameter of the window—only 12 to 16 millimeters in circumference—which limited observation to one brain section or hemisphere. The methyl methacrylate plates now used in the Navy experiments are a distinct improvement on all previous arrangements, in that direct observation of both sections of the brain is permitted.

The preparation of the monkey, *macacus rhesus* species, is in four stages: 1) preparation, 2) processing of transparent plastic plates, 3) attachment of plates, and 4) post-operative care. In the opening stage the monkey is bathed, anesthetized and shaved. After making a Y-shaped incision in the animal's skull (Fig. 2), muscles are laid back (Fig. 3), two sections of bone are removed (Fig. 4), and an impression is made (Fig. 5). The scalp is then closed with a rubberized helmet which is provided as a protection to the wound.

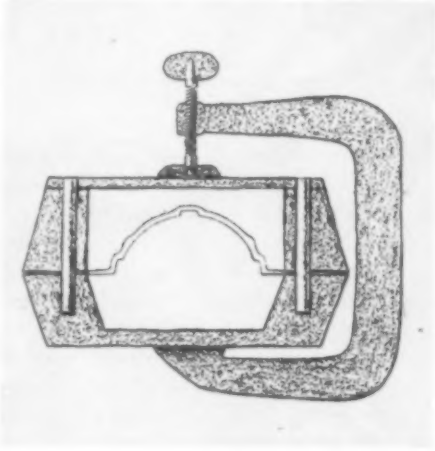
In the processing of the methyl methacrylate head plate, an impression of the area to be covered is made with great care since the correct fit depends on the first impression. An impression tray—made of aluminum, 1 mm. thick—is prepared. This metal lends itself easily to reshaping for later operations A stout wire loop is attached to the outer surface of the tray for quick removal of the impression from the skull. After the correct impression is obtained, a working model is made from dental stone (Fig. 6). When hardened, the stone model is separated from the impression and a wax plate, later duplicated in methyl methacrylate, is constructed on the stone model (Fig. 7). A standard dental base-plate wax is used for this purpose.

A standard sectional denture flask is employed in the construction of the mold for processing the methyl-methacrylate caps. The lower half of the flask is filled with equal parts of dental stone and a plaster of Paris. While the dental stone and plaster of Paris are still soft, the wax-covered stone model is embedded in this mixture, the plaster being allowed to cover the margin of the wax. The upper half of the flask is then filled with a similar plaster mixture, and both halves are allowed to harden. Upon hardening, the exposed surface of the plaster in both sections of the flask is covered with a film of soap to insure easy separation of the two halves when the molding operation is finished. When this is done the upper and lower halves of the flask are fitted together and the assembly is plunged into water for ten minutes. The heat melts out the wax covering the stone model leaving a space which later will be filled with the plastic compound. This space is next lined with tin foil to prevent seepage of methyl methacrylate into the pores of the plaster. The metal also assures a hard, clear finished product.

5—*An aluminum tray is used for the initial impression of the skull. A stout wire loop attached to the tray's outer surface insures quick removal*

6—*After the correct impression is obtained with the aluminum tray, a working model is made from dental stone, duplicating the skull contour*

7—*The dental stone is completely covered with wax which is made thicker at points where screws are to be used to hold the final plate in place*



8—*Cross section of the mold. Space into which the plastic is poured is lined with tin foil to prevent plastic from seeping into the dental stone*

9—*The transparent plastic skull cap is attached to the skull by means of four stout screws. The drainage holes are closed with brass screws*

10—*A cross section of the head with the methyl methacrylate plate in place, showing the relation of the plate to the skull and brain*

For processing, three parts of powder (polymerized methyl methacrylate) is placed in a glass beaker with one part of liquid methyl methacrylate monomer and allowed to stand for ten minutes. At the same time the mold is heated to 150° F. by the placing of the separated upper and lower sections in a shallow water bath for approximately one-half hour. When the mold is heated the plastic compound will have formed a jelly-like mass. Now, the methyl methacrylate is placed in the mold, and the mold is inserted in a mechanical press which is slowly closed (Fig. 8). Through gradual application of pressure the excess plastic escapes. In the next operation the mold is placed in boiling water for 45 min. to cure the methacrylate. The mold is cooled before the transparent plastic plate is removed. Then the tin foil is peeled away and any remaining pieces that adhere to the plastic cap are ground away with dental burrs and stones. The high luster on the finished cap is obtained with wet whiting on a high-speed rag wheel.

After an interval of 3 to 5 days the monkey is prepared for application of the sterilized methyl methacrylate plate which is firmly fixed to the animal's skull by means of four stout $^1/_8$-in. tantalum or vitalium screws (Figs. 9 and 10). Of 14 monkeys utilized in this experiment, only 4 have been subjected to the procedure outlined. The first 10 were used in the development of the technique. The amazing factor in the experiment is that monkeys show no behavior difficulties following the attachment of their transparent plastic skull plates. Most of them appear entirely unconcerned about their contribution to medical knowledge!

The methyl methacrylate plate method has proved very successful in direct observation of the brain. Saving of time is one of the method's greatest contributions. The processing technique requiring only about $1^1/_2$ hr. of work, with the initial preparation and final placement of the plate consuming about 2 hr. for each stage. It is the opinion of the men who developed the plastic plate method that it is adaptable for study of a wide variety of brain phenomena. Of even greater interest to the industry is the fact that plastics have again helped save human lives. Experiments of this type may solve the mystery that now surrounds the cause of death from shock and head wounds now so common in modern warfare.

Credits—Material: Lucite. Experimental work conducted by Navy Medical Corps.

ALL PHOTOS, COURTESY DUREZ PLASTICS AND CHEMICALS, INC.

1—These standard types of diamond dust wheels have been successfully compression molded with a phenolic body

2—Front and rear views of standard size wheels which are used for the cutting of extremely hard materials

Phenolics speed lens grinding

FOR two centuries or more lens grinding has been an art—one that demanded long apprenticeship, one that required the touch of the artist. All this has been changed by World War II.

Today lenses can be ground to within two wave lengths of light by a mechanical method. The war's demands for thousands of lenses, the perfection of which determines to no small degree the effectiveness and accuracy of our military maneuvering, necessitated the development of such a method.

The development of this lens-grinding machine necessarily included the design of a new type of grinding wheel, called a lens generator ring (Fig. 3). It naturally follows that many sizes of these rings are required for the many sizes of lenses.

While a great deal of the rough grinding is done with metal-hubbed rings, the finest finishes require the type of ring shown in Fig. 3—a molded phenolic hub and a phenolic-resin-bonded diamond dust grinding rim. The manufacture of these molded rings is extremely interesting and is patterned after that of the standard molded phenolic diamond dust wheels.

3—A typical lens generator ring used for the finest finishing. This ring consists of a molded phenolic hub and a phenolic resin bonded diamond dust grinding rim

The value and use of these rings are determined by the particle size and percentage of diamond dust. In the standard wheels variance of particle size is not so vital. However, in a ring which, for example, is supposed to be of 4-micron particle-sized diamond dust, just one particle of 10-micron dust will cause a pattern in the lens which renders it unfit for the desired curve or light-wave length. The same is true of the filler used with the diamond dust—the filler determining the hardness of the wheel. A further demand is made of the phenolic resin used to bond the filler, the dust and the rim to the ring. It must be of dependable purity.

In the production of standard diamond dust abrasive wheels, the value and use of the wheels are determined by the material to be ground and the speeds at which it may be ground. These wheels are used for cutting extremely hard materials such as tungsten carbide or for cutting synthetic sapphires required in the production of precision bearings.

Until recently, common practice among the grinding wheel manufacturers called for a steel body or hub around which was formed the grinding rim. This method of manufacture seemed essential in order to hold the rim to a specific dimension, and it seemed expedient both from a cost and waste standpoint to hold to a given thickness since this grinding surface contains diamond dust. When some manufacturers attempted to change over to a compression-molded plastic body or hub, the problem of maintaining this specific thickness dimension proved to be the greatest stumbling block. The great success with which the manufacturing company overcame this difficulty is evident in the various types of diamond dust wheels produced by this firm (Figs. 1 and 2).

The body or hub is first preformed of a high-impact phenolic molding compound. The grinding rim of diamond dust, filler and phenolic-resin bonding agent is also preformed. The two preforms are then molded under heat and pressure.

Credits—Material: Durez. Molded by George A. Greenlee Co.

PLASTICS IN REVIEW

1 Teething infants and their harassed parents should welcome Willy-Nilly Rings which, when conditions permit full-scale production, will be available in many sizes and colors. More sanitary and indestructible than most toys, the tough little Tenite teethers are fabricated from extruded stock by Wilson Products Co. Extrusion of these rings is by Carter Products Co.

2 The visual gage, product of Sheffield Corp., for which this plastic case head was designed is employed in checking tools, measuring precision parts and accurate examinations. Molded in two parts by Dimco Plastics, the housing is of Bakelite, chosen for its exceptional shock resistance, and provides adequate protection for the delicate mechanism

3 Drinking water coming into the home will be safeguarded against germs and other foreign matter by use of the X L water purifier, designed to fit any faucet, which is now offered by American Excel-Distel Filter Corp. Injection molded in two parts of Loalin by Atlantic Plastics, Inc., the unit acts as strainer, filter and purifier

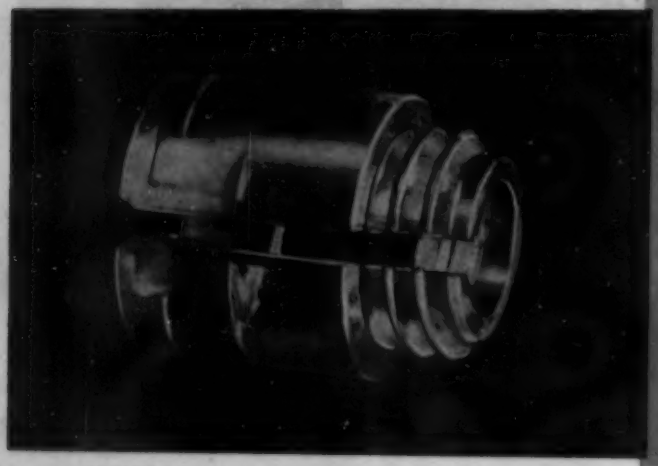
4 Its rolling hinge distinguishes a safety razor box for G. I.'s, injection molded in two parts of black Tenite II by Foster-Grant Co., Inc., for Gillette Safety Razor Co. A specially designed automatic drill and rolling device snaps the lid over lugs molded in the base. The Bakelite razor handle, compression molded by Plastimold, Inc., fits neatly into the trough of the rolling hinge

PLASTICS

5 When a rocket leaves the muzzle of a bazooka there is always the danger that particles may be blown backward into the eyes and faces of the men on the bazooka team. To protect himself against this possibility, a soldier launching bazooka rockets now wears a 3 1/4-oz. face mask developed by the Quartermaster Corps in cooperation with the Infantry Board. A pair of goggles of the M-1943 type protects his eyes without in any way impairing his vision. The lenses are fabricated of 0.033 in. thick Fibestos sheet. Attached to the goggles is a skirt of cloth which has been coated with vinyl resin. This skirt extends an inch below the wearer's chin and protects the sides as well as the front of his face. The complete mask is held in place by means of an adjustable strap of elastic webbing, 1/2 in. wide. American Optical Co. is the prime contractor

6 There's really no excuse for parched lawns and drooping flowers. Use a hose nozzle molded by Plastic Die & Tool Corp. of bright red Tenite II. A far-reaching stream can be changed to a dense spray by a quarter-turn of the nozzle which juxtaposes four small round holes of the inner section at various points along four elliptical holes inside the nozzle head. Threads molded into the nozzle secure it to the hose coupling. As with all hose attachments and other garden accessories, it is wise to put the nozzle away when it is not in use

7 Here today and gone tomorrow when you don't need it, the Nupla hook recently developed by New Plastic Corp. solves the problem of unsightly fixtures. A slight push with the finger and it disappears into the wall leaving a smooth surface. Molded of Beetle or any all-purpose phenolic molding powder, the hook is adaptable for closet doors, automobiles and many other applications. The material's resistance to humidity makes the part ideal for use in laundries and bathrooms where steam is apt to be present. The hook is available in two types—round for wood surfaces and square for tile surfaces



8 Although it's less than an inch long, a plastic priming adaptor is big enough to blow little Japs out of their little caves. Injection molded of transparent Lucite by Precision Plastics Co., the adaptor (here shown four times its actual size) is used for connecting a detonator to the explosive it sets off. When a detonator is assembled in the field, its fuse is slipped through the adaptor, its cap crimped on, and it is then ready to be screwed into a charge of high explosive by means of the detonator's threaded end. The light weight of the thermoplastic, its good electrical properties, dictated its choice as a replacement for metal

IN REVIEW

9 A pleasing addition to the already distinctive line of plastic furniture which designers have planned for the postwar living room is this attractive coffee table fabricated by Lawrence and Hunter. All plastic down to the blocks and screws and glue which are employed in its construction, the table has an oval top of Catalin in shining black and graceful legs formed of clear Lucite

10 When conversation runs low at cocktail parties, this light, transparent set of four coasters and tray recently put on the market by Vargish and Co. will give your guests something to talk about. Machined from sheets of Plexiglas, the plastic material which has been used so extensively for bomber noses and gun turrets, these attractive coasters will lessen chances of furniture's being stained by damp glasses or dishes, thereby easing the worries of the meticulous hostess

11 To combat the hazard of deafness, a constant foe of industrial workers in plants where noise is excessive, John L. Brill & Assoc. has developed "Noise Masters" of Lucite molded by Gary Molded Plastics to fit the individual ear. These are said to reduce loudness of surrounding noises up to 45 percent in low frequencies and 65 percent in high, allowing ordinary conversation at close range to be heard without distortion

12 Movie star technique of applying lipstick is made easy by "Brush'n Blend," product of Natone Co., which offers lipstick and applicator brush together in a handy two-compartment holder injection molded in one piece of Lumarith. The brush handle of the same material is grooved to insure a firm grip. Molding is by Allied Plastics Co. and Modglin Co. The case which contains the lipstick is of metal

13 Lighter and less expensive than metal, the chunky little plastic table tools used on American Airlines ships have nevertheless a solid, friendly feeling in the hand. Because the ivory Melmac of which they are molded has outstanding insulating qualities, they can't scorch lip or finger. Repeat orders placed with the molder, Northern Industrial Chemical Co., indicate that these knives, forks and spoons are meeting with the general approval both of the passengers and of the airline

Angle frame solves molding problem

IN what direction shall we go as far as molding procedure is concerned?" This was the question which confronted the Sperzel Sanitary Seat Co. and the molder when a decision was made to switch production from a short seat pad to a new long pad.

The former seat had been compression molded, a method which had created considerable extra labor expense because of the necessity, for reasons of sanitation, of removing ejector pin marks and flash, and of plugging and polishing support pin holes. The new seat pad is designed with a long core pin which serves two purposes. This insert acts as the hinge for the seat and has the effect of reducing the amount of molding material used in each of the parts. If compression molding had continued to be used with this new pad and its long insert, a support pin would again have been necessary and the attendant finishing costs would again have been high. For this reason, transfer molding was decided upon.

Inasmuch as these new long pads have a total area of approximately 90 sq. in., transfer molding by the conventional method would have required approximately 350 tons of clamping pressure. However, the only available press had a capacity of but 200 tons. So that this equipment could be used, the press was equipped with a universal angle frame[1,2] which almost doubled the capacity of the 200-ton machine.

The mold was designed and made to shoot in tandem—that is, one cavity above the other (Fig. 2). Although the angle frame was built to use universal transfer pots, it was decided in order to save tooling up time to place these particular transfer pots directly in the mold proper. The mold is made in four sections—the two center sections being bolted together and suspended as a unit between the upper and lower members. This center unit is supported from the upper plate by means of four sliding bolts which allow the center sections to drop vertically as much as six inches. The upper and the lower mold members are keyed to the grids. When the mold is closed, the core pins act as keys between the upper and lower members and the center unit. Thus, the key effect is transmitted throughout the mold.

The transfer cycle of the angle frame is operated from the same power source as that which actuates the large clamping ram. Thus, the pressure against the mold is always balanced on both sides. This arrangement coupled with the keys in the mold and the clamping pressure of the large ram prevents any shift in the mold. The angle-frame rams, or side arms, are capable of exerting a pressure of 50 tons each.

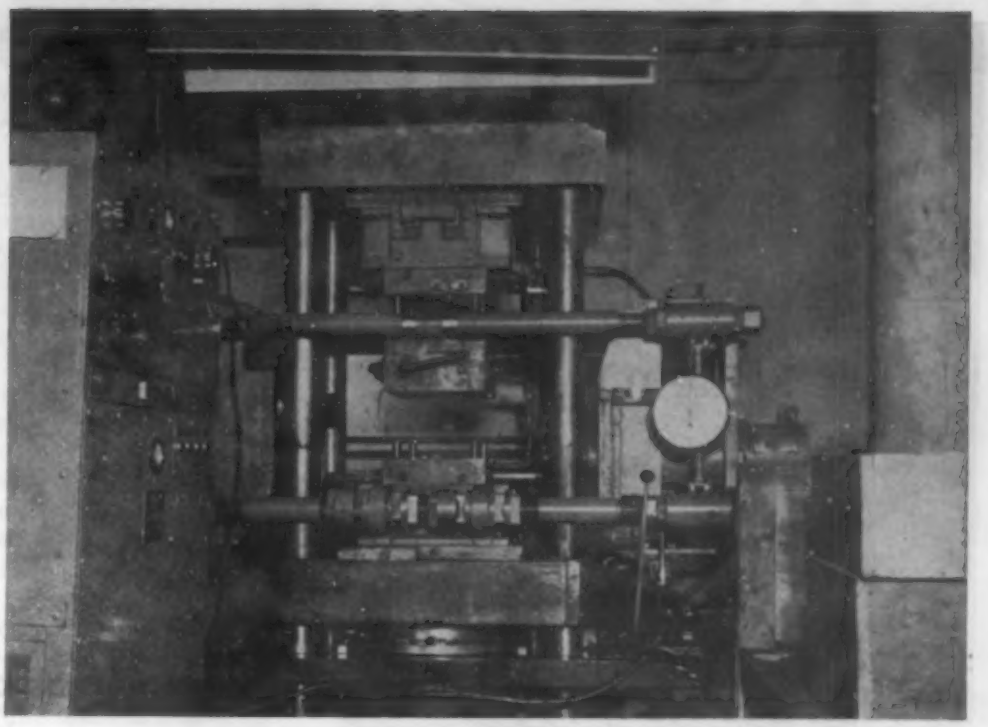
To insure ample pressure, the molders of this long seat pad designed and built a 280-ton press specifically for this operation. This press is now in use in place of the 200-ton capacity machine originally considered for this molding job. However, experimentation showed that when high-frequency preheating is used in this operation, the transfer molding requires only 150 tons pressure to hold the mold closed. Had this fact been known previously, a smaller press could have been used.

[1] A new development of the Rogers Hydraulic Co. and S. K. Moxness of the Minneapolis-Honeywell Regulator Co.

[2] "Transfer mold design considerations," by J. H. Dubois, MODERN PLASTICS *22*, 138–140, 206 (Nov. 1944).

ALL PHOTOS, COURTESY SPERZEL SANITARY SEAT CO.

1—Use of a high-frequency preheating unit reduces the amount of pressure necessary to hold the mold closed to 150 tons. This unit is designed with a drawer arrangement which, when filled with preforms, can be pushed back into place in the machine



2—Addition of a universal angle frame has doubled the capacity of this press, shown with the mold open. The four parts of the mold are clearly visible. The two center sections are bolted together and suspended between the upper and lower members

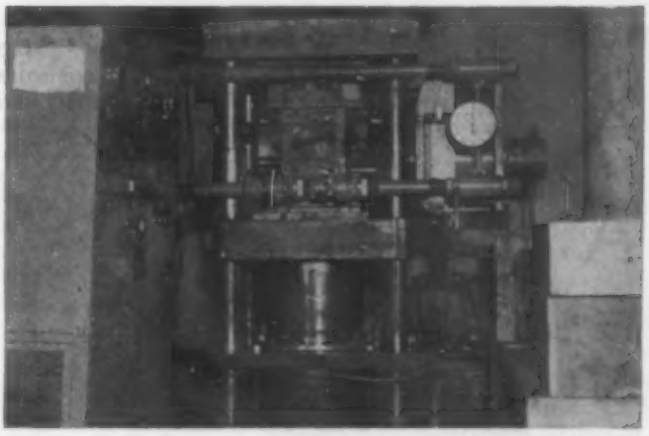
The transfer cylinders in the angle frame, working in $3^5/_8$-in. diameter pots, require a pressure of approximately 25 tons each to shoot 3 lb. of general-purpose phenolic molding material into the die. The injection time is between 12 and 15 seconds. It was felt that the cycle could be speeded and material saved if the die were run with a split-gate transfer. With such a setup production estimates ran from 15 to 18 shots per hour. After only a few weeks of operation with these split-gate transfer pots, production reached the point where nearly 14 shots per hour were being turned out—and this despite the fact that none of the operators was particularly skilled in the operation of this new type of equipment. It seems possible that, within a short time, 18 to 20 shots per hour can be obtained. Although this new long seat pad is about $^7/_8$ in. thick and, in consequence, requires a considerable curing time, the molding cycles have been cut to $4^1/_4$ minutes. This compares favorably with the early cycles which required 6 to 7 minutes.

The sprue left on each pad at the end of the molding cycle is easily removed. It can either be broken off by hand or by tapping with a light hammer. Then comes a quick polishing operation and the pad is ready for shipment.

Much time and effort were expended in the development of safety devices which would make it impossible for the large clamping ram to be opened while the transfer rams on the angle frame are still in the pots. Such premature openings will bend or break the lower or left ram, resulting in costly repairs. It was found that a solenoid, so arranged that it drops a pin behind the control valve which actuates the clamping ram, prevents the valve from being operated until the transfer ram is drawn back out of the mold. Then the pin drops out of position and releases the control valve.

Use of the angle frame for this long pin seat pad did more than solve the problem of using a small press for the transfer molding of this comparatively large part. It also speeded production by turning out two seats at one time from molds built to shoot in tandem.

Credits—Material: General-purpose phenolic molding compound. Molded by Plastics, Inc., for Sperzel Sanitary Seat Co.



3—When the mold is closed, the core pins act as keys between the upper and lower members and the center unit

4—The long core pin in the new seat pad serves as a hinge and also reduces the amount of molding material needed

ALL PHOTOS, COURTESY MINNESOTA MINING AND MANUFACTURING CO.

1—Visible only to the source of light activating their reflective qualities, these airport runway markers make night landings at blacked-out airfields possible. They are especially effective on fields which are near enemy territory

Reflective signs and markers

by ALLEN WAGNER*

Tiny glass beads, some 5000 to the square inch, are applied to a resin film with a control accurate to 1/10,000 of an inch to form a reflective material, widely used as landing and highway strip markers, and as railroad cross bucks

A WAY out in St. Paul, Minnesota, far from the places where there has been any need for blackouts, "when the lights go on again all over the world" is more than a catchy phrase or the title of a popular song to a research-minded company which has originated a new use for resin plastics. For the bright lights of peacetime will afford this company the first real opportunity to demonstrate what its resin-made reflective material known as "Scotchlite"[1] will do. Not that the material hasn't already proved itself in various ingenious war uses as an effective weapon for good, but that civilian applications will provide a wider field of development for its possibilities.

Born in the days before the war, this reflective material was introduced for highway markers, bridge abutments, railroad cross bucks and other safety markers, as well as for commercial advertising signs. At first its tiny glass beads, some 5000 to the square inch, were adhered to a treated paper backing with a rubber cement. Rubber cement also was used to bond the coated paper to the back of the sign.

The old and the new

But when rubber and other critical material restrictions came along, synthetic resins stepped in and went to work—not to advance this new product for commercial uses, but to turn it into a vital factor in the nation's war program. Resins now do the entire job. There is no longer any paper in the backing of this material—the glass beads are coated on a resin film. Resin even secures the bead-covered film to the backing of the sign. As has been true in so many cases, plastics are doing a more effective job than did the materials which were in use before the war.

Made from carefully selected glass, the beads that cover the surface of the reflective material are perfect spheres, having a diameter about twice the thickness of a human hair. The flexible, waterproofing backing film, to which the beads are coated on specially designed equipment, is produced from a water-white synthetic resin which was plasticized by a method developed and perfected in one of the company's own laboratories.

In appearance this material seems to be nothing more than a flexible resin backing to which innumerable glass beads are bonded. To obtain high reflective brilliance, however, the beads must be applied with a control accurate to $^{1}/_{10,000}$ of an inch. Thus each individual bead is made to perform as a minute optical lens.

The light rays striking the material are focussed by the beads to points on the highly reflective back surface of the material, much as the sun's rays can be made to burn when focussed accurately through a burning glass. These bright focal points then act as thousands of tiny sources of light which are projected out through the beads back to the source. In contrast to a movie screen which reflects a light about three times as bright as white paint, the reflection from this resin-bonded material runs as high as 150 times the brightness of white paint. Further, the beads and plasticized film are at least as durable as a coating of the best-quality paint which can be obtained.

Made in continuous sheet form, this material can be used to render entire sign surfaces reflective, and signs made in this manner have the same shape, color and legend at night that they do in the daytime. This greatly increases the effectiveness and facilitates recognition of standard signs, since the familiar daytime appearance is reproduced at night. The reflective material is made in six colors—white and yellow for

* Assistant to the Secretary, Minnesota Mining and Manufacturing Co.
[1] Manufactured by Minnesota Mining and Manufacturing Co.

use in the traffic field; green, blue and red for application in the advertising field; and silver, which can be used in either the traffic or the advertising field.

Wartime uses

Typical of the wartime applications of this reflective material are markers for airfield runways which make it possible for arriving pilots to find their way back to safe landings at home ports using only small wing lights. After signs of this type are installed, there is no necessity for lighting up an entire field and running the possible risk of attracting the attention of enemy aircraft.

Then there is the practice of coating the blades of pneumatic life-raft oars, which enhances the chances for after-dark rescue of American airmen and Navy personnel who find themselves stranded in mid-ocean. Thousands of strips of this reflective material, cut to fit oar blades, have been sent to oar manufacturers so that their products can be made reflective before being placed in life rafts. In addition, the company has evolved a compact package, $5^1/_2$ by $1^5/_8$ by $1^5/_8$ in., which contains three strips cut to the size and shape of oar blades, together with the necessary adhesive, a small brush and illustrated instructions for applying the adhesive. These packages are installed in life rafts equipped with oars which have not been coated with any surfacing.

Harbor buoys and ships' docks are coated with this material. Reflection of light back to its source makes these installations visible only to ships flashing their lights on the coated spheres. Military Signal Corps also makes excellent use of the material. It is also employed in quick alignment of gun sites on fixed guns, on Army roadside delineators and traffic control signs, and on Medical Corps signs which facilitate the location of first-aid and hospital facilities. On virtually all of the world's battlefronts, as well as on America's highways, trucks carrying explosives are marked with strips of this reflective material, so that any danger of collision, especially at night, is obviated by the glow of the reflective signs from the lights of any approaching vehicle.

In the days ahead

Plans are in the making for postwar expansion of the line to include a series of colored reflectors for commercial advertising purposes which will permit the sign manufacturer to make a sign in any pattern of colors which he may choose. Experimental signs made in this manner present a highly unusual night-time appearance, and suggest unlimited possibilities for variation of form.

As for the part this plastic material may play in making the nation's highways safer, it is interesting to note what Ross C. Harger, assistant traffic engineer of Detroit, had to say in an article in the *American City* magazine for March 1943, comparing what he termed "new style" signs and "old style" signs. According to Mr. Harger's estimate, these new signs will cost less than half as much as the old. "The new assembly contains the minimum in critical materials and is as neat and attractive as the old. Because of the greater area of reflective material employed on the new sign, the reflecting ability, readability and the target value of the sign are considerably improved when this new material is used. Further, manufacturing costs have been reduced 60 percent due to the use of less expensive materials and to a subsequent saving in many man hours of labor."

Credits: Material developed by Minnesota Mining and Manufacturing Company

2—*With many ordnance plants located in remote areas, the possibility of missing them at night is obviated by use of reflective signs set at judicious spots so that light from oncoming traffic strikes directly on them*

3—*Danger of collision with trucks hauling explosives is greater at night than during the day when warning signs are visible. Effectiveness of these reflective markers at night is evident in these day and night views*

DESIGNERS HAVE ALREADY DISCOVERED the decorative and functional possibilities of thermoplastics in creating distinctive lighting effects, and the resultant lamps and light shields are definitely practical as well as artistic.

For example, one designer presents a lamp shade with natural pressed flowers or plants, which have been preserved by a special process, set between two sheets of translucent cellulose acetate. These sheets, cut to a previously determined design, may be uncolored, or the one nearest the bulb may be of any pastel. The sides of the shade are affixed to a wire frame with raffia or—war conditions permitting—sturdy plastic threads. Wood or porcelain forms the base of the lamp. The matte finish of the plastic sheets presents a softly shaded effect that is both flattering to the room and restful to the eye.

Created by an artist to complement an equally individual base, the lamp shown in the accompanying illustration has a delicate pattern of Queen Anne's lace arranged between two uncolored translucent sheets of cellulose acetate. Slender strips of raffia woven through perforations around the edges of the plastic secure the shade to the wire frame. The base of the lamp is made of ceramic covered with a gun metal glaze.

Credits—Material: Shade, Lumarith. Base and shade designed and specially made for Styne and Ballard, Inc.

PLASTICS

WHILE THE AVERAGE HOUSEWIFE HAS faced the current shortage of household appliances philosophically, she has watched her electric iron reach a state of decrepitude with an increasingly anxious eye. Will her iron hold out until she can replace it?

However, her postwar reward for her patience will be greater than she anticipates. Present plans call for a cordless iron which draws heat from brief contact with a thermostatically controlled safety base. Elimination of the rheostat and the cord from the iron itself permits use of a larger, heavier iron heating section without corresponding weight increase. Rheostat cord and heat outlets are contained in the base.

Plastics in the iron proper are confined to the handle which is molded in a right and left section of two grades of phenolic. The two inches of handle nearest the iron are of higher heat resistance than the rest of the handle.

In the stand, the switching mechanism is contained in an oblong switch case of molded general-purpose phenolic set underneath the base. The insulator bushing which fits around the contact pins in the terminal block is of cold-molded phenolic and the block itself is encased in a molded phenolic case. The knob control is a stock mold phenolic item in black with white gradations. One of the trickiest plastics parts is located in the thermostat control button. This part, has a countersunk square in one side and a hexagonal pattern in the reverse, with a precision hole cut into one face.

Credits—Handle: Durez, molded by Auburn Button Co. Switch case: Durez, molded by Midwest Molding Co. Control knob: general-purpose phenolic, molded by Kurz-Kasch, Inc. Insulator bushing: Aico No. 1, molded by American Insulator Corp. Iron designed by Geo. W. Walker

THE LAST QUICK TEST GAGE WHICH DETERMINES the acceptance or the rejection of a finished product such as a plug must necessarily be highly accurate. Therefore, the gages used in testing these parts must of themselves be free from any imperfection or tendency to sudden change from rising temperature or any other adverse effects. For this reason handles made of cellulose acetate butyrate are the ideal complement to these sapphire test gages.

In the manufacture of the handles for these gages continuously extruded rods of red translucent cellulose acetate butyrate are cut to a predetermined length. These rods are extruded in a hexagonal shape in order to keep the gage from rolling when laid on a flat surface. The ends are then drilled to receive the two gaging members and are finally threaded and slotted to receive a split threaded bushing with a locking nut which secures the sapphire "go" and "no go" testing ends of the gage to the plastic handle. Use of this bushing has been made possible through the qualities of resiliency and toughness inherent in the butyrate.

Since fine gaging is improved by sensitive touch, the light weight of the plastic handle is an important factor in the proper functioning of the testing instrument. Too, the excellent thermal insulating properties of the handle minimize changing temperature effects which transmitted from the operator's hand, distort the accuracy of the gage. Both the cellulose acetate butyrate handle and the sapphire parts are nonmagnetic, a factor which permits the use of the gage near magnetic chucks and steel gaging members.

After the handle has been engraved with the name of the manufacturer and the gage specifications, it is buffed to a high luster and enameled. The completed gage, which seems more like a piece of expensive jewelry than a workman's tool, is then ready to be encased in its plush-lined box of hand-rubbed mahogany.

Credits—Material: Tenite II. Gage handles extruded by Sandee Manufacturing Co. for Elgin National Watch Co.

PRODUCTS*

SINCE MECHANICS AND TECHNICIANS CANnot be kept constantly on guard at each section of the vast network of wires and circuits that thread communication facilities, endless numbers of silent, mechanical watchmen have been devised to take their place. These guards, which range from a simple, uncomplicated mechanism to a highly complex structure, are used in some instances to prevent trouble and in others to indicate that the regular machinery is out of order. For example, lightning arresters filled with rare gas guard fire alarm and telephone and telegraph circuits against that most unpredictable of elements.

These arresters, which must be impervious to constant weathering and shock, are protected by housings of transparent cellulose acetate butyrate. The housings, which are molded in two halves, fit around the cartridge and fasten by means of interlocking lugs which are formed with the halves in the mold. The two metal ends of the cartridge are then slipped on over the outside of the plastic housing.

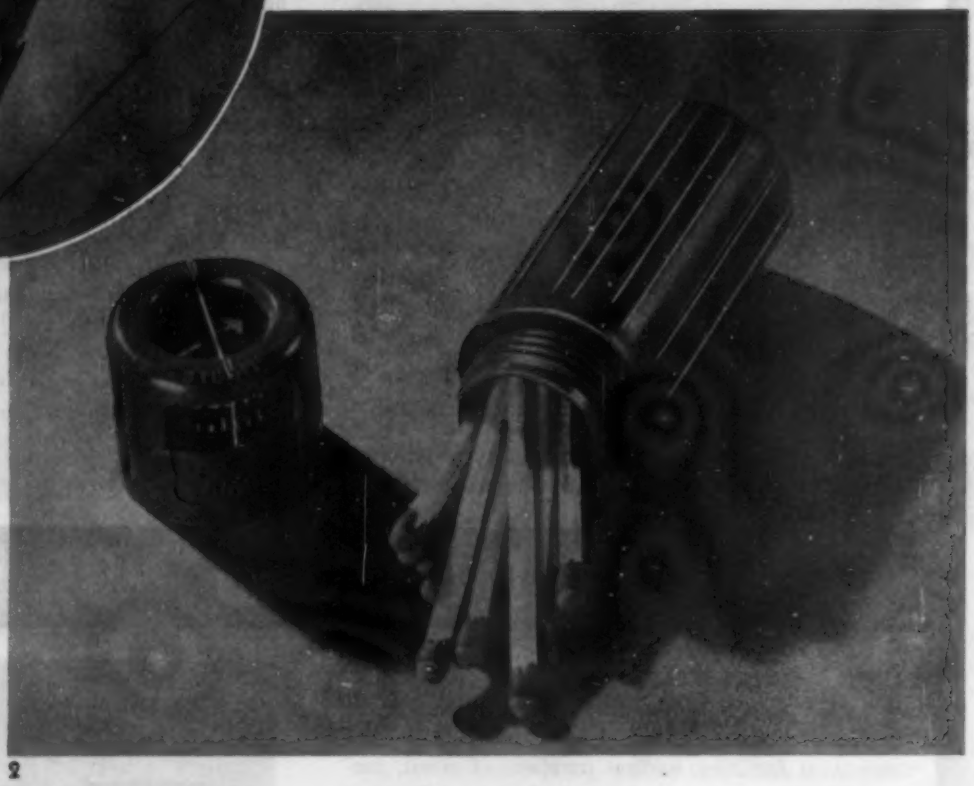
The transparency of the housing permits immediate vision of the glow which indicates proper functioning of the arrester in the presence of lightning or of high-voltage circuits.

Credits—Material: Tenite II. Housings molded by Sterling Plastics Co. for L. S. Brach Manufacturing Corp.

* Reg. U. S. Patent Office.

A foolproof and practical compass

1



2

1 and 2—A small but vital requirement for the life vest of every fighter pilot is this card-type liquid compass, affixed in a case holding waterproof matches

IN the South Pacific a young American fighter pilot flew unerringly back to his base 600 miles distant after the compass on his instrument panel had been destroyed by enemy fire. Another pilot, forced down in remote territory, guided his crew to the safety of their own lines without once being at a loss as to directions. These are but two typical examples of many reports stemming from our front-line forces which illustrate the usefulness of a little pocket compass which is now standard equipment in the life vest worn by every fighter pilot and all crew members of the B-29 superfortress. The case of this instrument, which is designed to hold matches, is molded of cellulose acetate butyrate while the compass dial is of cellulose acetate and the window is of cellulose acetate butyrate.

An Air Corps flyer's wife, the story goes, originated the idea of the life vest through her habit of cramming into her husband's pockets every conceivable article which he might find useful if he were forced down in remote territory. The life vest, which evolved from her solicitude, contains a fishing kit, mess kit, food, firefighting equipment and a plastic pocket compass. This compass, officially designated as "compass, liquid filled, Type H-2, with match container," is, in fact, the most essential part of the contents of this vest. Reported to be the first card-type liquid compass for the pocket ever made available, it has helped many a flyer find his way home. Success of the unit is best signified by the fact that the Army Air Corps has placed orders for hundreds of thousands of these handy instruments.

Basically, the unit is a pocket-size dial-type liquid compass attached to a case which holds two layers of waterproof half-size matches. The entire article weighs less than two ounces and resembles a flashlight battery—3 in. high and 1 in. in diameter. Such a fine degree of accuracy is required in manufacture of the compass—which contains 16 separate parts—that a variance of .5/1000 would result in rejection.

The compass sight is viewed through the top of the tubular instrument. A luminous white arrow, visible in the dark, points to the North. Through a side window, bearing the caption "You Are Looking," the bearer can determine the exact direction he faces. On the side of the lower section of the compass case is a small strip of flint, made of Pyrophoric metal, which produces a spark when the edge of a steel knife is drawn across the length of the striking bar.

Military specifications for this pocket compass call for the same rigid tests as those given to standard compasses on B-29's and other fighting aircraft. This is necessary because the all-purpose pocket compass must be able to stand up under the multitude of varying conditions which might be encountered in combat. To insure these instruments' meeting AAF specifications 5, chosen (*Please turn to page 196*)

Molded-in inserts versus drilled holes

In molding the phenolic firing block and fuze-setting ring that form the heart of the firing and expelling mechanism of the Navy parachute flare, specifications calling for molded-in inserts where drilled assembly holes would have served as well, have added considerably to the cost and slowed production

LIGHT is, for the most part, a stranger to this war. The majority of night operations are conducted in darkness, instruments rather than light being used to direct the operation of equipment. There are, however, exceptions to this blackout ruling. And upon such occasions the Navy places considerable dependence on parachute flares which, when dropped from planes, are capable of lighting wide areas.

During the ten years that preceded the outbreak of war, the Navy experimented in a small way with these flares. Consequently, although funds for this development work were limited, the Navy was in a position almost immediately after Pearl Harbor to go into production on a thoroughly tested and carefully engineered parachute flare. The principal requirements for this flare were:

1. That it be made of materials which would be available despite the gravest wartime scarcities.
2. That it be so designed that its parts would be easy to produce and assemble.
3. That it have optimum positive operation even under such adverse conditions as are likely to be encountered at sea. Among these conditions can be listed continuous salt spray, icing, temperatures as high as 140° F. and as low as −50° F., and high shock due to concussion resulting from the near-misses of anti-aircraft fire.
4. That it be designed to afford positive safety in storage, handling and operation.

The essential parts of a parachute flare are a magnesium flare, a parachute, a tubular container and a controllable firing mechanism. The first three items—the flare, parachute and container—presented no major design or production problems. The firing and expelling mechanism was another matter, however, and efforts of the designers and engineers were largely concentrated on this assembly.

Once the decision was made to use a Bickford safety fuze instead of a mechanical fuze for timing and ignition purposes, a model firing block and fuze-setting ring were constructed from wood. At this point a plastics molder was called in who, because of inexperience, included in the design several costly items which should never have been employed in the production of these two pieces which are molded of high-impact phenolic material.

In order to hold the firing block in the tubular container, it was decided to mold in eight No. 6-32 inserts, spaced at equal intervals around the outside periphery of the molded block. The inserts were also adopted as a means of holding the fuze-setting ring in the firing block, four inserts being spaced at equal intervals around the outside edge of this molded ring. When assembled, the phenolic firing block and fuze-setting ring were held together securely by four screws threaded through matching inserts in the block and ring. Similarly, the assembled firing mechanism—the firing block and fuze-setting ring—was held in the tubular container by

1—The firing block and fuze-setting ring, which form the heart of the firing and expelling mechanism of the parachute flare, are transfer molded of high-impact phenolic. The numbers and the letters on the ring are filled with white paint to make them more legible

* Reg. U.S. Patent Office

eight screws which engaged with the eight inserts molded in the firing block.

To mold these inserts in both phenolic pieces, it was necessary to insert very small diameter pins in the sides of both chases of the mold. Due to the terrific vertical pressure exerted on these pins by compression molding, pin breakage was very high. This had the effect of increasing costs on two counts. Not only did the purchase of new pins add to the expense, but the pin breakage cut down the production rate very considerably, since each piece molded with a broken side pin was of necessity a rejected part.

At this point, a second molder was called into consultation. He recommended that these parts be molded by transfer molding since this molding method would eliminate most of the vertical strain on the side pins. After one single cavity transfer mold had been put into production, it was found that the pin breakage difficulty was practically eliminated.

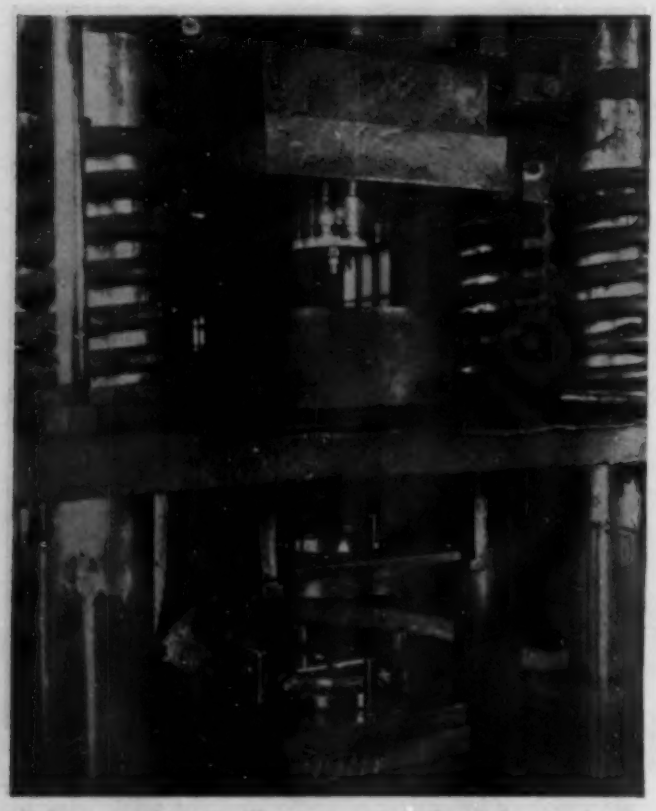
It would, however, have been far more practical to eliminate the inserts entirely and, by means of a multiple drilling head and tapping head, drill all the holes in each piece at one and the same time. A second operation for tapping the holes would then have completed the work. With side pins eliminated, both of the pieces could have been molded in multiple-cavity compression molds without any trouble at all. And in addition, the consequent elimination of the inserts from the parts would have saved not only money but also strategic material.

However, before Naval Ordnance could be convinced that drilled and tapped holes were as good as inserts for this application, the design was frozen. It is well to note that it is specifically stated that drilled and tapped holes are equal to threaded inserts for *this application* inasmuch as this is a case where, once the screws are assembled into the tapped holes, there is no reason to remove them. If this were a thread and screw assembly which had as its normal function the assembly and disassembly of the screws, a threaded insert would be far more satisfactory due to the fact that a thread formed in the molding material tends to chip and wear when used repeatedly.

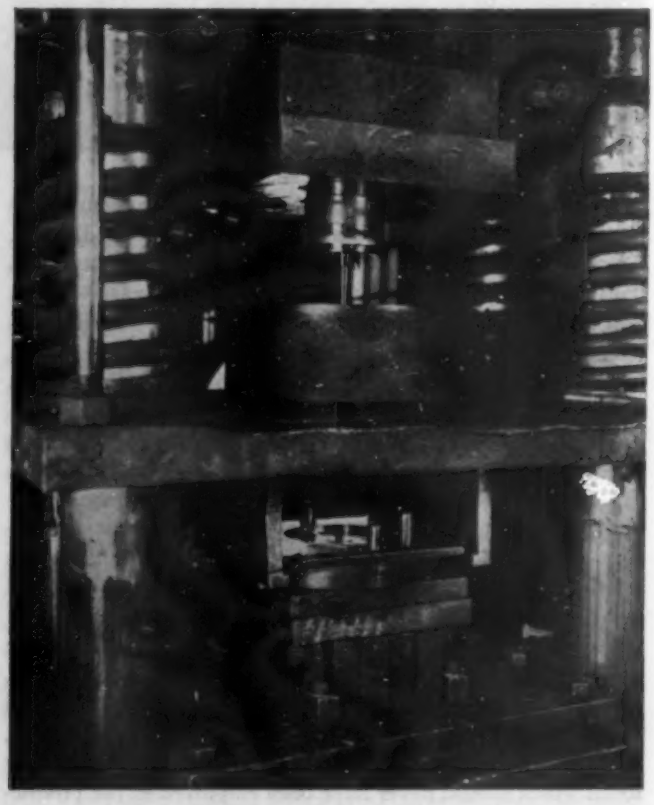
As production requirements on this job increased, several additional transfer molds were produced for each of the parts, and ways and means of speeding the cycle were investigated. This was made easier by the fact that the molding operations for both the firing block and fuze-setting ring were somewhat similar in process.

For each of the parts, the side pins contained in the mold were threaded so that the inserts could be screwed on them and thus be held in position in the mold. These $^1/_4$-in. long inserts had eight threads. Consequently, to secure the inserts in position it was necessary to turn either the insert or the threaded mold pin eight times. A spiral ratchet screw driver was used for this job. This type of screw driver made the insert assembly very fast and, at the same time, expedited the ejection of the molded parts. It was necessary, of course, for the four threaded mold pins in the ring and the eight threaded mold pins in the base to be unscrewed from their respective inserts before the molded part could be knocked out of the chase.

Some difficulty was encountered with warpage and undue shrinkage of the rings. This shrinkage caused a very loose assembly between the ring and the base which was objectionable to the Navy. To correct this condition, it was necessary to turn up a set of shrink plugs on which the rings were assembled immediately upon removal from the mold. When allowed to cool on these plugs, the rings were found to be of satisfactory dimension



2—*The single-cavity transfer mold used for the molding of the fuze-setting ring is here shown in the open position, the cavity suspended above the force plug*



3—*The transfer operation completed, the ring mold is partially opened. Cull and sprue hang suspended on the plunger. Force plug and cavity are still assembled*

4—Once the plug and cavity have been separated, the operator removes the cavity which still contains the molded ring. The part is then ejected from the cavity by hand, the four runners designed like spokes of a wheel are cut away from inside the ring and the flash removed

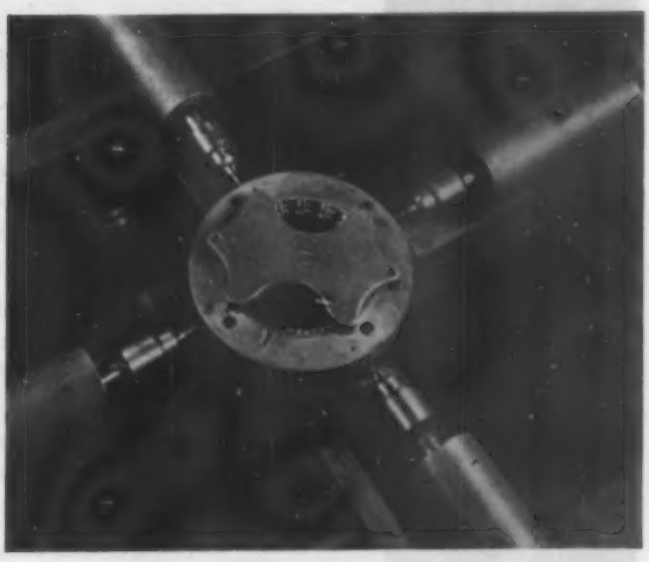
An additional difficulty was encountered from time to time when inserts with slightly over-sized threads were used. In such cases, some of the resin tended to flow into the threads. This difficulty was eliminated by having each insert retapped after molding. In other words, in order to catch the very few parts with plugged-up threads, each insert was tapped whether it needed it or not.

From a survey of the difference in costs, it was found that if the inserts which caused most of the molding problems had been eliminated, a 6-cavity compression mold running in a 15-in. ram press would have given approximately the same daily production as four single cavity transfer molds. The setup would then have been a six-cavity compression mold for the firing block and a six-cavity compression mold for the fuze-setting ring, each mold running in a 15-in. ram press. Since one molder would have been used on each press, this arrangement would have required the attention of six molders all 24 hours of the day.

For the same production, but using transfer molds and side inserts, four single-cavity transfer molds are needed for the firing block, each running in a 10-in. ram transfer press which requires two men for its operation. Add to this four single-cavity transfer molds for the fuze-setting ring, each operating in a 7-in. ram transfer press manned by one molder, and the total man power is found to be 36 men working all 24 hours of the day. And the total number of presses employed is eight.

Due to the fact that the side holes must be drilled and tapped if the side inserts are eliminated, the labor of four operators per day must be added to the finishing department labor if compression molding is employed. While it is a generally accepted fact that finishing labor is paid less than molding labor, it shall be assumed that the rate of pay is the same so that the final configuration cannot be questioned. The following figures give a vivid picture (*Please turn to page 196*)

5—A molded ring is slid into place on a multiple drilling unit in preparation for the drilling of side assembly holes



6—Four holes are drilled in the fuze-setting ring while it is held firmly in place by the locking nut plate

7—To insure that all threaded brass inserts in the firing block are free of phenolic material, each insert molded in the part is retapped whether it needs it or not

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Die and hobbing steels for plastics molds*

by RAY P. KELLS†

TO ONE interested in industrial progress, the tremendous strides made by plastics have been the outstanding industrial achievement of the past ten years. And the war has served to accelerate this expansion of the plastics industry. We in the tool and die steel business have watched the growth of this industry, have noted the infinite variety of molded and cast plastics, and have worked unceasingly to develop mold and die steels that meet the requirements of this field.

Due to the varying characteristics of the many different plastics materials, die-steel development must keep pace with developments in the plastics industry if the proper die steel is to be selected for particular assignments. This may mean the development of many die steels. Those who work in plastics must realize that the selection of the correct die steel is important. Plastics users should not take just any die steel that is offered for sale. Problems and requirements are so varied that the time spent in the selection of the die steel that fits the need will do much to solve plastics production problems.

There are numerous factors to be considered in the selection of a steel for molds or dies. For instance, the making of the die has an important bearing on this matter. First the steels that are applicable for this type of work should be examined; then the economic picture should be clarified.

The type of die steel selected for a particular application depends upon the nature or characteristics of the material being formed. Close tolerances on the finished part may make the use of a machined mold rather than a hobbed one advisable. If the plastic material is abrasive, it is desirable to use a die steel that contains alloys which resist this abrasive action. Some plastics are highly corrosive, and the processing of such a material demands the use of a die steel that will resist corrosion. There is a special type for each of these requirements or for combinations of these requirements.

In the selection of mold and die material for plastics, as well as in the selection of steels for other purposes, price is often a dominating factor. Frequently this is poor economy because the cost of steel is usually a very small percentage of the cost of the finished tool or die. A case in point is a plastic mold built of low-cost alloy steel. The cost of machining and finishing this die was over $5000. Upon completion the die was heat treated, and it warped to such an extent as to be virtually worthless. When polished, the die was found to have so great a porosity that it was valueless. A die steel suited to the needs and design for the particular application was applied and worked out to the complete satisfaction of all concerned and the cost of the actual metal used on the second die was only $19.00 more than that used in the original mold. This is an extreme case, of course, but it does illustrate the importance of selecting the best die steel for the job in hand. It also indicates that quality leads to real economy in operation.

What are the requirements of a mold or die material? First, it must be clean and free from porosity. Second, it must not deform in hardening. Third, it must harden to a relatively high hardness and to a depth sufficient to resist sinking under high pressures. Fourth, it must in many cases be able to resist the abrasive action of plastics. Fifth, when corrosive plastics are used, the die material must resist this action. Finally, it must meet all requirements insofar as fabrication of the mold is concerned. Under this heading comes hobbing and/or machining, and heat treatment.

Cleanliness of the die steel means that the metal must be free from inherent defects such as inclusions, blow-holes or bursts. Structure is also important, particularly in die steel, since a large-grained steel cannot be polished to a high finish. A large-grain structure results in a mottled or alligator surface.

The furnishing of quality steels is, of course, the problem of the tool steel manufacturer, but it is a problem that must be met in everyday competition in the tool and die steel field. The tool steel producer, therefore, is accustomed to meeting a very high standard of product quality. The ability of the die steel to maintain size and shape during and after heat treatment is of primary importance. In the beginning of the plastics business, production was largely in novelties and similar items where dimensional tolerance was no particular problem. Now this has been changed. As plastics move into precision parts, it is to be expected that tolerances will be much closer and more exacting. Such tolerances make the use of a non-deforming die steel imperative. Furthermore, plastic molds and dies are being called upon to withstand ever-increasing pressures in service, and sinking or marking must therefore be prevented. If a mold cannot be hardened to a sufficiently high hardness or cannot be hardened with sufficient case depth, sinking is likely to occur.

Die steel strength is best measured by its compressive strength. Where the question is one of the ability of the metal to withstand abrasion, this can be judged not only by the measurement of the material's hardness but also by the alloys it contains. Thus, although two different steels may be treated to an identical hardness, one may have many times the wear resistance of the other. As an illustration of this point, consider a straight carbon-steel die as compared with one made of steel containing a reasonable amount of chromium. When both dies are treated to the same hardness, the die containing the chromium will have far better wear-resisting properties.

Steels that will resist extreme corrosion are now in demand by the plastics industry. There are many instances where machine operators, finishing a run, neglect to clean the molds or to protect them against corrosion by the application of a coating of grease. When corrosion occurs—and it can take place between shifts or overnight—many hours of polishing are needed to rectify the condition. In some cases, the mold may be so badly corroded as to be entirely worthless. A corrosion-resistant die steel does not require such meticulous care. In these days of indifferent or inexperienced labor, a die steel that suits the job condition is an insurance against both mold or production loss.

A discussion of plastic die steels would not be complete without a discussion of machining or hobbing. Mold and die manufacturers would probably like to hob all cavities, but from a practical standpoint this is impossible. Either the

* Based upon talk given before Pittsburgh Plastic Engineers Society at Mellon Institute, Pittsburgh, Pa., November 20, 1944.

† Chief service engineer, Latrobe Electric Steel Co.

design or size of the finished cavity may be such that hobbing is impractical, or the physical strength required will prohibit the use of a low-alloy die material soft enough for satisfactory hobbing. When it becomes necessary to use a die steel containing the proper quantities of alloys to produce high tensile strength, resistance to abrasion or to corrosion, the mold cavities, unless they are rather shallow or small, must be machined. When a machined mold is the correct answer, machinability naturally becomes an important characteristic of the die steel.

The ease of machining, however, must not be permitted to influence the die steel selection even though so far as machinability is concerned such a mold would be very satisfactory and could be heat treated to a satisfactory hardness. In order to make such die steels so that they machine freely, alloys may be added to form inclusions or to produce the discontinuity in the material that facilitates this work. When such a mold is polished it is found to be full of inclusions. If the inclusions do not appear in the polishing, they will be very much in evidence when the mold is put to use. Such steels are not and cannot be used for molds or dies since the alloys that are added to ease the machining operation ordinarily contribute nothing but trouble in mold life. Despite the fact that alloys cannot be successfully added to produce satisfactory die steels with free machining properties, no great difficulty is being experienced at present in the machining of these molds. This may be attributed to the fact that a plastic die steel, when properly made, is carefully processed to insure the best possible machining properties.

Heat treatment of the mold or die is the next step. Die steels must be capable of attaining relatively high hardnesses from about Rockwell C 55 to Rockwell C 65. It is necessary, of course, to carburize or cyanide the very low carbon die steels to obtain such hardnesses. If heat-treating equipment is not available, commercial heat treaters are generally able to do a good job, and if heat-treating equipment is available, the services of a metallurgical service engineer will be of great advantage in setting up correct heat treatment in the hardening operation. Such procedure also assures a finished die free from hardening pits, scale or deformation.

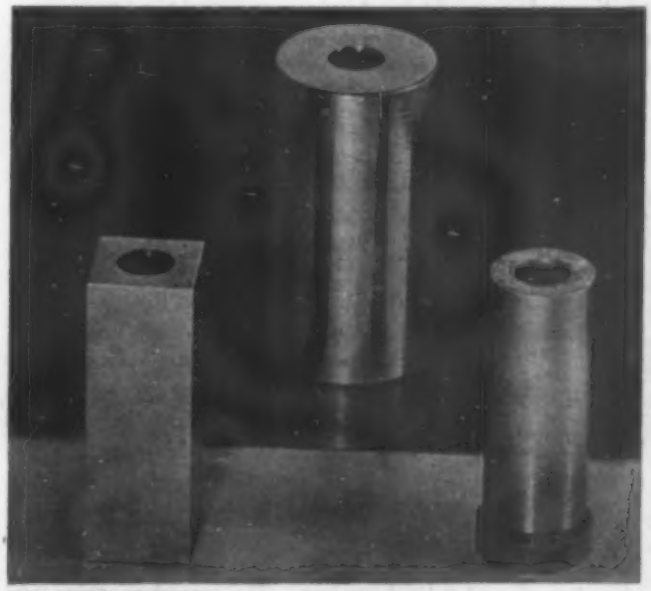
After this brief summary of the various characteristics required in mold materials, the next logical step is an examination of the available die steels with a view to the selection of the die steel best suited for the particular requirements. First consider a low carbon alloy that can be hobbed without difficulty. In this discussion, typical analyses will be given rather than a recommended range. In other words, these recommendations are based on an actual die steel used satisfactorily for this purpose. A typical analysis of this easy-to-hob material is: carbon, 0.03; silicon, 0.15; manganese, 0.15; sulfur, 0.025 max.; phosphorous, 0.025 max.; and chromium, 0.03 maximum. This is practically a pure iron. As in the case of all die steels, it must of necessity be melted under conditions of very close control to insure complete freedom from porosity, physical defects or inclusions.

Even with the rigid controls maintained in tool steel melting, metallurgical engineers recognize that only a part of each ingot can be used if good quality and uniformity are to be maintained. After annealing, this selected mold and die steel has a Brinell hardness of about 95 and can be hobbed very readily in the annealed state. In the annealed condition, the hobbed mold is not satisfactory for use and must be carburized, then reheated, water quenched and drawn to obtain the desired hardness. By following this procedure, a cavity with case hardness and a tough, ductile core results.

However, a die cavity made from this hobbing steel will not have the resistance to abrasion or corrosion that is possessed by some steels. If the hobbed cavities are deep and intricate, some movement in hardening may be expected because of stresses set up in the hobbing operation. Such stress may be relieved to some extent and final deformation minimized, if the die is stress-relieved by an anneal after the hobbing has been completed or only partly completed. This can be done by heating to about 1300° F., followed by an air cool. A better practice is to anneal at about 1600° F. and furnace cool. After this stress-relieving anneal, the hob may then be reset. The hobbing operation completed, the mold or die should be packed in a carburizing compound and heated to 1600 to 1650° F. for a sufficient length of time to produce the case necessary. After the carburizing operation, the die should be removed from the furnace and cooled slowly in the carburizing box. When cold, or at about 500° F., the mold should be removed from the box before it has a chance to harden.

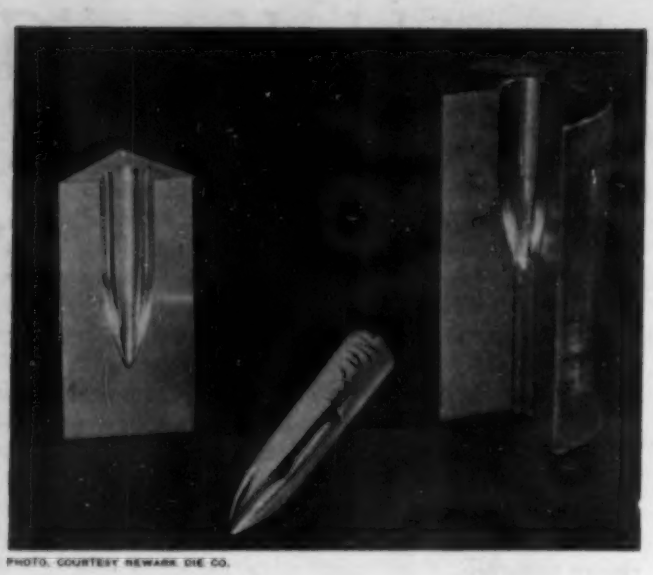
As far as the case is concerned, straight carbon steel is what results from the carburizing operation. It is necessary, therefore, to reheat to about 1450° F. and quench in clean water or brine to get the required hardness. After hardening, draw at about 350° F. This will produce a hardness of about Rockwell C 62. There is a word of caution which should be inserted at this point. If not properly quenched, straight carbon steels are subject to soft spots. This is also very true of carburized iron. For this reason, it is necessary in many cases to resort to the use of a flush quench to insure rapid and uniform cooling of all vital surfaces. Every plastic mold—hobbed or machined—has a variety of wall thicknesses within itself, yet for proper hardening it must be quenched in a uniform manner over-all. For best results, this may require some particular metallurgical engineering procedures. It is, however, of the utmost importance for, if some parts of the cavity were to cool too slowly, soft spots and a poor die would result.

As has been indicated, molds or dies of this very low carbon



PHOTO, COURTESY NEWARK DIE CO.

1—After the blank (center) is hobbed, it can be finished either to a round or to a square shape before it is hardened. However, sufficient material should be left to permit finish grinding to size after hardening



PHOTO, COURTESY NEWARK DIE CO.

2—The perfect finish obtainable by the hobbing technique is evident in the two hobbings—rough (right) and square finished (left)—shown cut away in section. No polishing has been done on these cavities. Note how much longer the hob (center) is than the cavities which have been produced in the steel hobbings

die steel will not resist abrasion or corrosion as satisfactorily as other die steels which will be mentioned later. Neither will they maintain size as accurately throughout the processing procedure of hobbing, hardening, etc. However, where these special characteristics are not required and where there are no special problems, the economy and ease of fabrication of this low carbon die steel cannot be surpassed.

There is another good mold steel which contains approximately 0.10 carbon, 0.50 manganese, 0.50 chromium and 1.25 nickel. This is furnished at about 120 Brinell hardness. While this is a somewhat higher hardness than the straight iron type, it is still within the hobbing range. In many cases, on die steel of this higher hardness, two hobbing operations are used with an intervening anneal to relieve the stresses set up by these cold working operations. After the cavities are shaped, the mold should be carburized at 1600 to 1650° F., removed from the furnace and cooled in the box or container. For proper hardness, it should then be removed from the container, reheated to 1450° F. and quenched in either oil or water. The drawing temperature most generally used for this is 300° F. Water quenching is recommended for large or heavy sections.

Heretofore, only the ordinary low carbon die steels have been discussed—those to be used when there are no "special problems" present. As newer plastic materials are used, however, and more accurate and strict tolerances enforced, the use of a die steel that aids in control of these factors becomes more and more necessary. In this group of die steels are the oil-hardening non-deforming types.

There are two such die steels with somewhat similar analyses. The first or original type contains 0.92 carbon, 0.32 silicon, 1.55 manganese, 0.025 max. sulfur, 0.025 max. phosphorous and 0.18 chromium. The second contains 0.94 carbon, 0.33 silicon, 1.23 manganese, 0.025 max. sulphur, 0.025 max. phosphorous, 0.57 tungsten and 0.44 chromium. These die steels are furnished with a maximum Brinell hardness of 207, and at this hardness they may be hobbed if the impressions are simple and shallow. Even then, the procedure of annealing between successive hobbing operations is desirable.

The manufacturing methods used in processing and annealing these steels result in easy machining, and no unusual difficulty will be experienced in this operation. As a matter of fact, these die steels are rather popular in the plastics industry because of their ready machinability. Annealing after machining is also desirable to relieve stresses set up in the machining of the die, and this care often prevents premature cracking of the mold. The heat treatment recommended for the type containing 1.55 manganese is: heat to 1450° F., then oil quench and draw at 350 to 400° F. to obtain a hardness of Rockwell C 60–63. For the hardening of the second type—the steel containing tungsten—heat to 1500 to 1525° F., oil quench and draw at 350 to 400° F. to obtain the same hardness mentioned above. These two die steels have a number of the desired qualities, but they are still not as resistant to abrasion or corrosion as is sometimes required. Therefore, it is necessary to select another die steel containing more alloys.

One of these which is now being used to a very great degree for machined molds is a type which contains 1.00 carbon, 0.30 silicon, 0.70 manganese, 0.025 max. sulfur and phosphorous, 0.25 vanadium, 5.25 chromium and 1.00 molybdenum. This die steel can be polished to an unusually high luster finish because of the chromium, manganese and molybdenum content. It is extremely resistant to abrasion and resists corrosion to a much greater extent than any of the other die steels that have been mentioned thus far. It is virtually non-deforming in heat treatment and air hardens by heating to 1750° F. and cooling in still air. For general-purpose molds or dies, it is drawn at about 400° F., which results in a Rockwell hardness of C 62–63.

Because it contains a rather high percentage of alloys, it cannot be hobbed with deep impressions. It is furnished at about 217 Brinell hardness and at this hardness is not difficult to machine. For machined molds, it is becoming increasingly popular. It is interesting to note that this die steel was used some fifteen odd years ago for the mold which cast the first plastic steering wheel ever made. The original analysis has been changed slightly as carbon content has been reduced from 1.35 to 1.00. This die steel, as well as the oil-hardening types mentioned above, is deep hardening and self-hardening. Carburizing is not necessary.

Another matter to be considered concerns what can be done to die steels to give them resistance to corrosion. It would be desirable to say that a certain die steel would resist corrosion entirely, but some plastic materials are so strongly acid that the problem of entirely preventing corrosion is not completely solved at this time. Research work is in progress, and the time is not too far distant when the most corrosive of all plastic materials may be handled in a die steel mold for long production runs. At present, the available stainless steels are a step in this direction. One stainless type that is highly resistant to corrosion is 18–8 stainless in the Austenitic condition. It is soft however. Until this characteristic can be changed and some means of case hardening developed without impairing the stainless qualities, the material's use for molds is not practical. There are, however, three types of stainless steels that resist corrosion extremely well. First, there is the 420 Type containing: 0.35 carbon, 0.35 max. silicon, 0.35 manganese, 0.025 sulfur max., 0.025 phosphorous max. and 13.50 chromium. This type when hardened in oil from 1825 to 1850° F. will attain a hardness of abont Rockwell C 53. The high chrome content is respon-

sible also for resistance to wear, and molds of Type 420 Stainless will consistently outwear some of the other steels having higher hardnesses.

The second type, or Type 440A, is the one most generally used in molds or dies for corrosion resistance. This contains 0.65 carbon, 0.35 silicon, 0.35 manganese, 0.025 sulfur and phosphorous and 17.50 chromium. It is hardened from 1850° F. with an oil quench to about Rockwell C 57. While it can be hardened in either air or oil, oil hardening is recommended where large sections are involved. Both these types are drawn at 350 to 400° F. and both are of the desirable non-deforming type of die steel. In the annealed state, Type 420 stainless can be supplied at a Brinell hardness of 170 whereas the annealed hardness of Type 440A stainless is about 207 Brinell.

There is still a third type of stainless die steel possible for use as a plastic mold material. If it is necessary to go a step further in order to obtain hardnessès higher than Rockwell C 57, the use of Type 440B stainless is recommended. This contains about 0.85 carbon and 17.50 chromium. Otherwise it is similar to Type 440A. This stainless die steel hardens from 1850° F. in either air or oil, but will attain a hardness of about Rockwell C 60. The 0.65 carbon analysis (or Type 440A) has the advantage of greater toughness. In the annealed condition, the Type 440B can be furnished at about 228 Brinell.

The material discussed up to this point has been steel and iron for molds and dies. But a consideration of this subject would not be complete without a brief word on tool steels used for master hobs. Master hobs and die steels for plastics must go hand in hand where a hobbed die or partly hobbed die may be used. It should be remembered that a combination of a hobbed and machined mold may often prove to be an economical procedure. The required piece may be of such design that it is not possible to hob the mold completely. However, it may, in some cases be possible to hob as much as 75 to 90 percent of the required cavity. After the hobbing, a stress-relieving anneal should be given the metal to make possible the machining of that part of the die which could not be hobbed.

The tool steel to be used for the master hob depends upon a variety of characteristics. Among these are the type of mold material to be hobbed, the depth of the hobbed cavity, the intricacy of the mold design and the relative stringency of tolerances and specifications. All of these involve a consideration of such measurable factors as freedom from deformation or movement in hardening, compressive strength, toughness, hardness and ease of hardening and handling.

In the tool steels, there are many steels that might do a satisfactory job as a master hob. From experience, it has been determined that a hardness of Rockwell C58 is generally found to be satisfactory for this work. Where the design, or some other factor, requires a slightly higher or lower hardness, it is suggested that the tool steel be hardened to its maximum hardness and the proper hardness obtained from the drawing temperature. Long drawing times are usually desirable and are recommended, with a draw of not less than 4 hr. suggested for a cross section of approximately 2 inches. Using this as a guide, larger hobs should be drawn proportionately longer.

Regardless of the type of tool steel used for master hobs, freedom from all inclusions, scale or pits and decarburization is a specific requirement. Hobbing steels should never be carburized. If high temperature salt baths are not available or if the all-important hardening furnaces with controlled atmospheres so necessary for surface protection are not within reach, it becomes necessary to resort to packing for proper hardening. After the usual anneal to relieve the machining strains set up by the final shaping, the finished hob should be placed in a pipe or box with the proper packing material to control carburization and decarburization. Packing materials used for surface protection have tendencies to either carburize or decarburize—depending upon temperature, time at temperature or the analysis of the steel being treated. Grey iron chips, from which the fine particles have been sifted, make satisfactory packing material for hardening finished hobs. Such a packing material used in the hardening container prevents scaling, preserves the fine surface so necessary in the finished hob and also holds the carbon of the tool steel used within reasonable limits.

As we mentioned before, there are many die steels that would do the job. For the sake of brevity, and to eliminate confusion usually caused when a multitude of different analyses are offered, the list has been narrowed to but three different hobbing steels. Analyses of these three, which are believed able to take care of 95 percent of the hobbing tool requirements, are as follows:

	C	*Si*	*Mn*	*Cr*	*Va*	*Ni*	*Mo*
Steel A	0.54	1.03	0.90	0.37	0.13	2.70	0.41
Steel B	1.00	0.30	0.70	5.25	0.25	...	1.00
Steel C	1.46	0.30	0.25	11.93	0.22	...	0.71

Heat treatment most generally used for each of these is:

Steel A—Quench from 1600 to 1625° F. Draw at 400° F. Hardness Rockwell C 58. This steel may be either air cooled or oil quenched from the hardening heat.

Steel B—Air cool from 1725 to 1750° F. Draw at 500° F. Hardness Rockwell C 58.

Steel C—Air cool from 1825 to 1850° F. Draw at 500° F. Hardness Rockwell C 58.

Of the three hobbing steels suggested, steel *A* is lowest in price. Steel *C*, because of the special alloys contained, is the highest priced tool steel suggested. All three of these will do the job required. Therefore, the selection made will depend upon the requirement of the particular job involved. For the most exacting work, requiring a master hob that does not distort during heat treatment and will serve to hob many molds and dies without failure, it is good judgment to use the very best that can be obtained as represented by steel *C*. In the final analysis, which of the three to be used should be dictated by good judgment.

Summary

In conclusion, it is deserving of mention to indicate that the trend in plastics mold and die steels is following a path similar to that followed in the past by metal forging dies, die casting dies, hot and cold metal working dies, etc. When these industries were young, emphasis was often placed upon the price of the die steel rather than upon the best quality that could be purchased for the job. As competition increased, tolerances became more exacting and inspection became much more critical. It was then that the research and study of the tool steel field was highly productive of both increased quality and improved economy.

In all research of this kind, it has been the goal of the tool steel producer to keep pace with the growth and trends of industry. It has been proved time and again that a tool or die steel-using-industry has much to gain by putting its trouble cards on the tool steel producer's table. If this procedure becomes a habit in the plastics field, and it should be a basis for every mold decision, both the plastics user and the tool steel producer have much to gain.

Laminac...

STRUCTURAL SECTIONS of the R-6 helicopter cabin, made of Fiberglas bonded with Cyanamid's low-pressure LAMINAC, are shown here in process of set-up on a simple fixture for forming into shape. No expensive or elaborate dies are necessary

plastic curves for Helicopters

You'd hardly expect to find four major improvements in a single change from metal to plastics! Yet that's what occurred when Sikorsky Aircraft's R-6 helicopter cabin structure was changed from metal to plastic.

1. The new glass fiber laminated structure—using LAMINAC*, Cyanamid's low-pressure, self-cementing resin—reduced the weight of the cabin frame by almost fifteen per cent.

2. The noise level was lowered because the material deadens sound.

3. The finished assembly was a compact, simplified structure made up of only twenty-six sub-assemblies glued and riveted together, replacing one composed of several hundred metal parts. The laminated sections had even more than the required strength—and, because of the ease of their fabrication, it was a simple matter to achieve the finished contours desired.

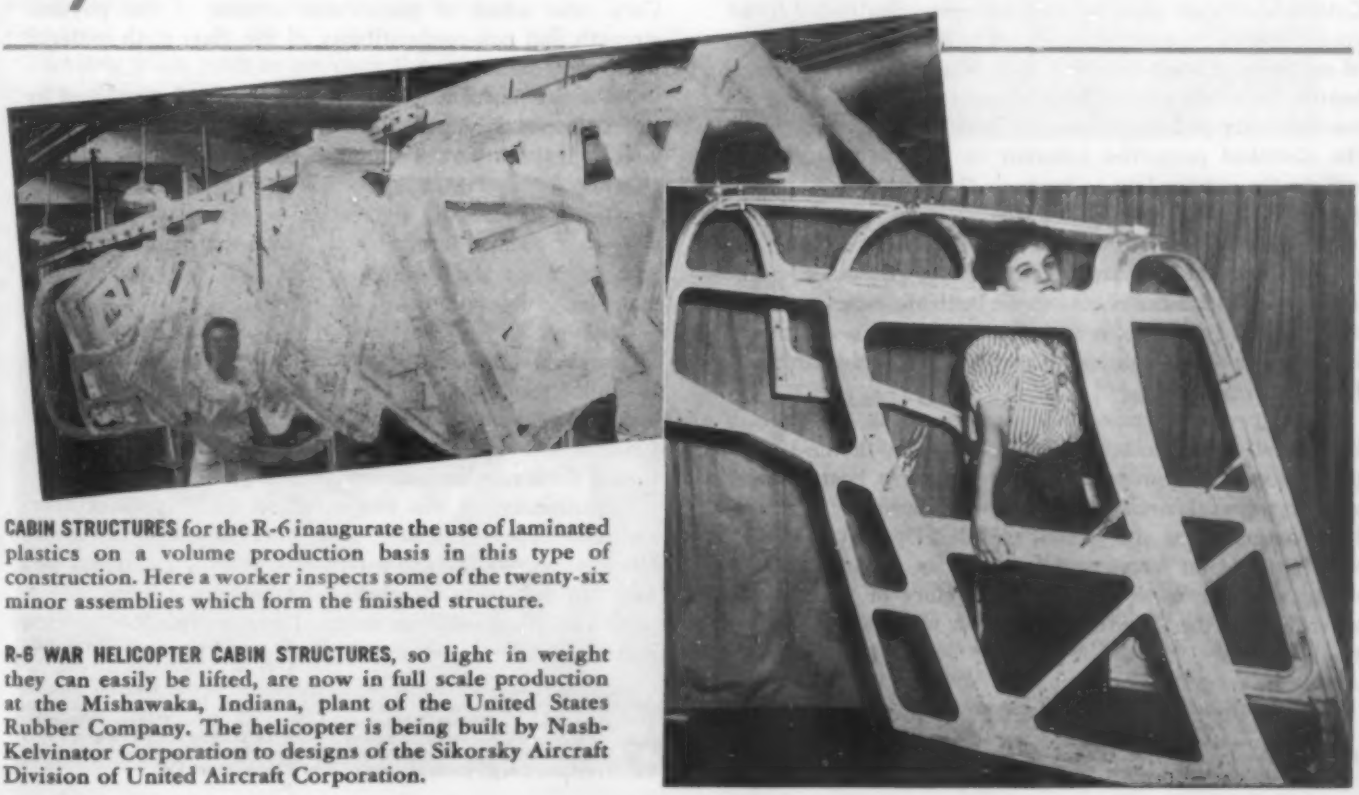
4. And of particular importance, the laminated cabin structure could be produced in approximately half the time!

Cyanamid's low-pressure LAMINAC may offer the solution to one of *your* design or engineering problems. We will be glad to send complete information or to work with you in developing designs and applications.

*Reg. U. S. Pat. Off.

AMERICAN CYANAMID COMPANY · PLASTICS DIVISION
30 ROCKEFELLER PLAZA · NEW YORK 20, N. Y.

Cyanamid Plastics — *Beetle · Melmac · Melurac · Laminac · Urac*



CABIN STRUCTURES for the R-6 inaugurate the use of laminated plastics on a volume production basis in this type of construction. Here a worker inspects some of the twenty-six minor assemblies which form the finished structure.

R-6 WAR HELICOPTER CABIN STRUCTURES, so light in weight they can easily be lifted, are now in full scale production at the Mishawaka, Indiana, plant of the United States Rubber Company. The helicopter is being built by Nash-Kelvinator Corporation to designs of the Sikorsky Aircraft Division of United Aircraft Corporation.

PHOTOS 1-4, COURTESY OWENS-CORNING FIBERGLAS CORP

1 2

1—In its intial stage, glass cloth for laminates is barrels full of shiny glass marbles, each of which weighs about a quarter of an ounce. 2—The marbles, which will be melted and drawn into continuous filament textile fibers, are formed in the spirals of a special machine. Those containing imperfections are discarded

Flame-resistant laminate for the Navy

by LOUIS C. CHESLEY and PRESCOTT C. FULLER*

SHORTLY after the United States entered the war, the Navy became aware of the need for a laminated insulating material which possessed high flame and arc resistance. Cotton-fabric-base phenol-formaldehyde laminates had found application in the electrical industry prior to the war because of numerous advantages over slate or ebony asbestos panel boards, including greater flexural and impact strength, good machinability and general ease of fabrication. Furthermore, the electrical properties inherent in these laminates were sufficiently outstanding to warrant their extensive application in the industry.

However, for use in the electrical insulation field, phenolic cotton-base laminates are deficient in arc resistance.[1] The average arc resistance of a phenolic laminate, when tested by the A.S.T.M. methods, is exceptionally low. In addition, a laminate which is made of this material has a comparatively low combustion point.[2, 3]

These two deficiencies made necessary the development of general- and specific-purpose laminates with the highest possible electrical properties. A desire for a board having greater physical strengths than those shown by a cotton-base laminate was also behind this development work. It was felt that an inorganic filler, such as glass or asbestos cloth, would increase the flame resistance of the material regardless of the type of resin which was used in forming the laminates.

A committee was formed consisting of Navy personnel, laminated insulation material suppliers, and manufacturers of electrical control equipment.[4] Owens-Corning Fiberglas Corp. was asked to participate because of the physical strength and non-combustibility of the glass cloth material which they produce.

Melamine-formaldehyde molding compounds produced by the American Cyanamid Co. were at that time being used in aircraft ignition parts because of their combination of good electrical insulating qualities with a high degree of arc and heat resistance. This application suggested the possibility of using melamine-formaldehyde resins with inorganic fillers to better meet the requirements of the Navy for suitable panel-board insulation.

Consequently, the material company, at its Stamford Research Laboratories, undertook to develop a suitable melamine resin. In cooperation with other members of the committee, the company evaluated melamine resins in combination with various fillers, and a technique for the production of these new laminates was developed.

Experimentation was conducted on three types of fillers and two types of resins. The fillers tested were cotton fabric, asbestos cloth and woven glass cloth. The resins used were an unmodified melamine-formaldehyde type and a phenol-modified melamine resin. Laminates made from these resins and fillers were tested extensively for both physical

* Plastics Division, American Cyanamid Co

[1] "Technical Data on Plastic Materials," P.M.M.A., 123 (May 1943).

[2] "Safeguard against shipboard fires," MODERN PLASTICS 22, 126 (March 1945).

[3] A.S.T.M. Bulletin No. 131, 26 (Dec. 1944).

[4] Manufacturers represented on the committee were: General Electric Co., Westinghouse Electric Corp., I.T.E. Circuit Breaker Co., Formica Insulation Co., Continental Diamond Fibre Co., Owens-Corning Fiberglas Corp., American Cyanamid Company, Panelyte Division of St. Regis Paper Co., Mica Insulator Co., National Vulcanized Fibre Co., Spaulding Fibre Co., Synthane Corp., Richardson Co., and Taylor Fibre Co.

and electrical properties. A study of the test data showed that a laminate made with glass cloth and an unmodified melamine-formaldehyde resin resulted in an exceedingly strong panel exhibiting outstanding electrical properties. Arc resistance of around 180 sec. A.S.T.M. test method was obtained. It was also found that the laminate would not support combustion.

Subsequently, two major drawbacks appeared. While the laminate under "as received" conditions shows insulation resistance values of about 100,000 megohms, it was found to experience a substantial drop in insulation resistance when tested under high relative humidity conditions. In addition, difficulties were encountered when an attempt was made to machine the laminate. So great was the need for this material that work was immediately undertaken to overcome these difficulties. Actual operating conditions showed that the relative humidity which would cause a great drop in insulation resistance was very seldom encountered, and that under normal humidity conditions, the insulating resistance was very high. It was also determined that the use of proper tooling equipment, such as carbaloy or diamond-tipped cutting equipment, made fabricating of this glass cloth melamine laminate practical.

At this phase of the investigation, a glass cloth base melamine resin laminate was accepted for electrical insulation purposes. This material is known under the name of Navy Type GMG.

Impregnating of glass cloth

It was found that a more intricate technique of handling had to be employed in the impregnation of glass cloth with a water solution of melamine resin than was necessary when cotton fabrics were impregnated with either a phenolic or melamine-formaldehyde resin. Glass fibers, before weaving, are treated with a lubricant or oil to prevent their abrasion and subsequent breakage during the weaving operation which would cause a drop in strength values. This, plus the fact that glass fibers are non-absorbent, inhibited resin pickup and its adhesion to the woven cloth. In addition, a water solution of melamine resin has a high surface tension and low viscosity.

An attempt was made to overcome this particular condition by the addition of 20 percent of either ethanol or isopropanol in the solvent system. This tended to lower the high surface tension of the resin solution without causing a detrimental decrease in viscosity.

When glass cloth impregnated with a resin solution of this 20 percent alcohol, 80 percent water solvent system was put through the drying operation, severe blistering resulted. The blistering was caused by the volatilization of the alcohol (which has a lower boiling point than water) and its blowing up of the fine film which had formed as soon as the wet resin-impregnated cloth passed into the heating zone. As the impregnated dried cloth traveled over the rollers after leaving the drying tunnel, flaking and subsequent large loss of resin was experienced due to the breaking of the bubbles or blisters formed in the drying phase.

Further development work

The next step was the elimination of either the ethanol or isopropanol from the solvent system and the use of a very small percentage of wetting agent added to an all-water solvent. This resulted in a smooth, wet coating of resin on the glass fabric. However, the treating speed with such a solution was considered too slow.

Concurrent with the development of a suitable solvent system, work was carried out on the resin impregnation and lamination of glass cloth from which the lubricant had been removed by washing with organic solvents. It was decided, however, that such washing or lubricating of the glass cloth would not constitute a gain in the physical or electrical properties and that this extra step was not warranted.

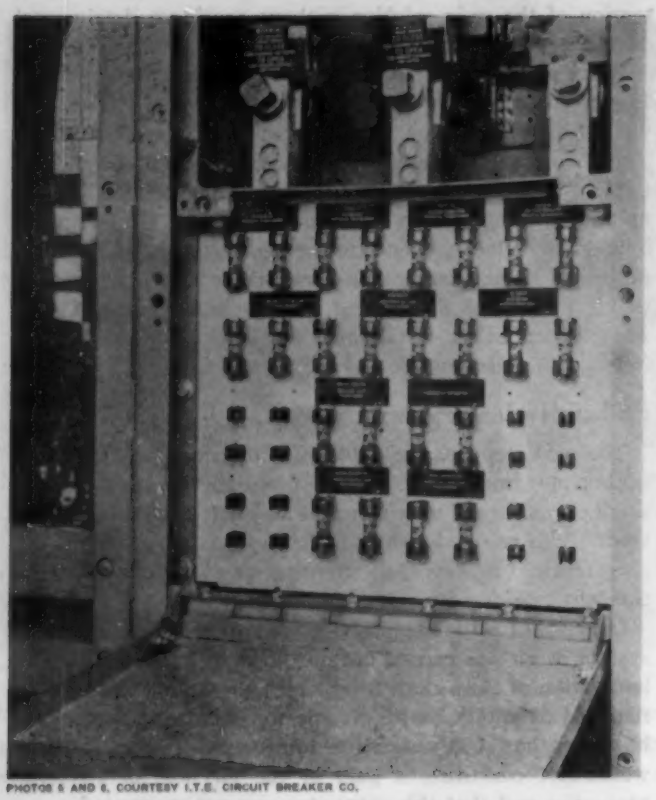
After the white type laminate had been in service for about

3

4

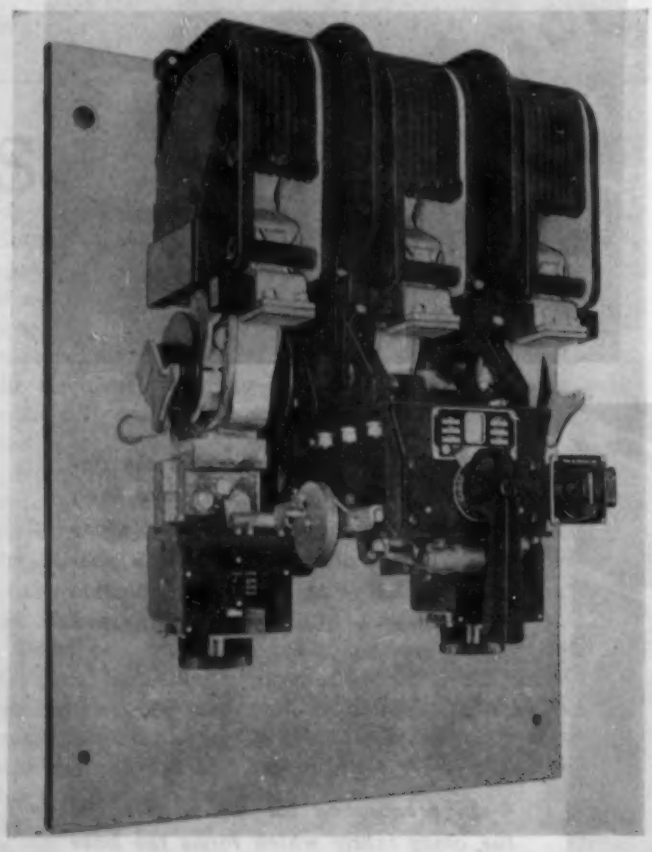
3—When they are drawn from the furnace in which the marbles have been melted, the continuous filament glass textile fibers are so fine that a special light must be thrown on them to make them visible to the inspectors

4—In preparation for the weaving of the glass fabric which forms the base for this new arc- and flame-resistant laminate, the warp yarns must be set up parallel to each other on a beam



PHOTOS 5 AND 6, COURTESY I.T.E. CIRCUIT BREAKER CO.

5—The glass cloth melamine laminate forms the panel board of a large generator and distribution unit



6—A circuit breaker mounted on a half-inch thick panel of glass cloth melamine resin laminate. The arc- and fire resistance of this laminated material is of special importance in electrical applications of this type

seven months, further investigation was undertaken in an attempt to increase even further the physical properties of this type of laminate. It was found that by heat-treating the glass fabric and thus removing a portion of the lubricant, better physical and electrical properties were obtained. Apparently, better impregnation of the fabric was achieved, resulting in higher bonding strength and better physical properties. Whereas the non-pyrolized or non-heat-treated glass cloth produced a white laminate, the pyrolized cloth resulted in a laminate with a medium brown color. Not only did this give the laminate a more uniform appearance, but it also reduced the staining that occurs when the white panels are wiped with an oily or dirty cloth.

The glass fabric used for this application has a thickness of 7 mils. Work was also carried out using glass cloth 14 mils thick, but it was found that a more uniform laminate resulted from the use of the 7 mils fabric.

A solvent system made of 5 percent N-Butanol and 95 percent water was next used. Since Butanol has a boiling point between 116 and 117° C., this alcohol portion would not volatilize at a rate faster than the water component. Blistering was thus eliminated. This led to the discovery that higher drying temperatures could be used with the resin, resulting in faster treating speeds. In a drying tunnel 60 ft. long, where an average temperature of about 320° F. is maintained by radiant heat from steam coils, speeds of between 10 and 12 ft. per min. were obtained. In contrast, drying temperatures in the range of 270 to 290° F. had resulted in treating speeds of 5 to 6 ft. per minute.

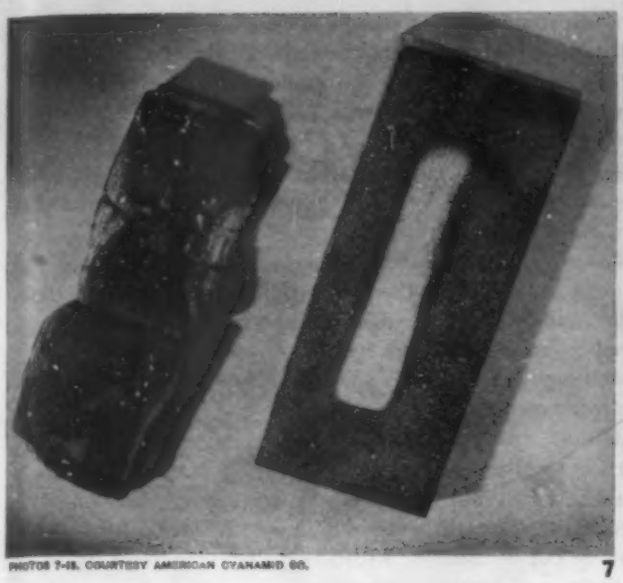
The development of this 5 percent N-Butanol, 95 percent water solution terminated experimentation with the addition of boric acid to a resin solution having an all-water solvent system. The use of such a catalyst made the "end point" of the drying operation too critical. That is, there was a danger of overcuring the resin, which would cause very inferior physical properties in the cured laminate.

A 60 percent solids content in the resin solution was found necessary to obtain the proper amount of pickup of resin by the cloth. A resin content of 36 to 40 percent—determined on the basis of the difference between the weight of the impregnated and dried fabric, and the weight of the unimpregnated fabric—was found to be optimum, giving the highest and most consistent bonding strengths. This property of a laminated panel is easily determined and it was used first as an initial criterion to determine whether or not the panel was properly cured, and also because it appeared to be the most critical physical property.

A resin content of over 40 percent resulted in quite severe crazing on the surface of the panel. Use of less than 36 percent resin content produced a laminate with minimum bonding strength which could hardly be tolerated for an application of this sort.

The standard volatile test, which is generally run by heating weighed samples of the impregnated fabric for 10 min. at 150° C. and then measuring the loss in weight in terms of percentage volatile loss, did not prove adequate. It is the opinion of the writers and others that a volatile test does not hold when the loss is 4 percent or less.

Indications were that the flow, or greenness, test would give a more accurate measurement of the polymerization of the resin as the impregnated cloth passed through the drying operation. In order to determine the percentage flow, a sufficient number of impregnated sheets, 3 by 3 in., to make a finished panel $^1/_{16}$ in. thick, are laid up and pressed in a hot press for from 5 to 7 min. at the pressure and temperature to



PHOTOS 7-8, COURTESY AMERICAN CYANAMID CO.

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7—A phenolic cotton-filled laminate and a glass fiber melamine laminate were both subjected to a temperature between 500 and 1000°F. for one hour. Sample at left shows appearance of the phenolic laminate after 10-min. exposure. Sample at right shows appearance of the glass melamine laminate at the completion of the test. 8—Molded glass fiber melamine tubing showing diversity of shapes and thicknesses which can be formed

be used in laminating. The sheets are weighed before laminating, the flash is removed after laminating, and the laminate is again weighed. The difference in weight should range between 2 and 5 percent, based on the weight of the unpressed sheets.

Technique in plant production

In plant production of glass-melamine laminates, unmodified melamine-formaldehyde resin is obtained in the form of a dry, white, free-flowing powder. Under vigorous agitation, 180 lb. of the dry resin is slowly added to 114 lb. of water in order to obtain a 300-lb. batch. The water may be heated to 70° C. to facilitate solubility. After the resin is in solution, 6 lb. of N-Butanol are added, and the resin solution is agitated for 10 to 15 min. longer to insure proper mixing. Approximately one hour is needed to dissolve the resin in the water component, and the resulting solution of 60 percent solids in a 5 percent N-Butanol, 95 percent water solvent system has a life of at least 48 hours.

When a Waldron-type impregnator is used, the resin solution is poured into the dip tank and the fabric impregnated by immersion. The squeeze rolls should be opened to about 12 or 13 mils. The temperature in the drying tunnel may be anywhere between 270 and 325° F. Speeds of from 10 to 12 ft. per min. are obtained if the drying temperature is held between 300 and 315° F., while the speed will be about 6 ft. per min. at a temperature of approximately 270° F. A flow test is run at least once every hour to insure uniform treating, and the flow can normally be held at 3 percent.

At a temperature of 68 to 75° F. and a relative humidity of about 40 percent, the impregnated fabric has a storage life of several weeks. This fabric may be cut to size by a guillotine cutter as it emerges from the treater or it may be stored in rolls and cut by a squirrel cage cutter or shears just before use.

Assemblies are laid up by weight. It was found that instead of trying to predict the final thickness of a laminate by measuring the height of a pile of impregnated sheets or by using a definite number of treated sheets, very close tolerance in the thickness of the finished panel could be obtained by using a certain weight of sheets.

After the assembly has been built up between polished steel cauls, it is placed between the platens of a multiple-opening hydraulic press. Pressure of about 1200 p.s.i. is applied and live steam is used to heat the press platens to a curing temperature ranging between 140 and 165° C.

When development work was begun on the glass-melamine laminate, it was felt that 140° C. was the optimum curing temperature. Later, however, it was found that the use of higher curing temperatures—up to 165° C.—did not lower either physical or electrical properties.

Curing time depends upon the thickness of the laminate. Generally speaking, one-half hour at the curing temperature is sufficient time to press and cure a $^1/_2$-in. thick laminate, while 15 to 20 min. at the curing temperature is sufficient for panels $^1/_8$ to $^1/_4$ in. in thickness. This does not include the time necessary for the press platens to come up to temperature or for the press to cool after the laminate is cured. The laminates are cooled to at least 90° F. under full pressure before the press is opened.

The press platens on both sides of the laminate must be heated and cooled at the same rate. This tends to bring the cured resin to equilibrium as more rapid cooling on one side would cause faster shrinkage of the resin on this side resulting in warpage of the laminate.

After it is removed from the press, the edges of the laminate are trimmed and it is ready to be machined before final use.

Machining equipment and techniques

It was originally thought that the machining of glass fiber melamine laminates presented serious problems because the reinforcing material is fibrous and quite abrasive. However, when the proper tools are used in combination with the proper technique, the material can be machined easily with ordinary shop equipment operated by machinists with metal-working experience.

The panel must be supported when it is cut or must be cut from both sides as in shearing. It is recommended that all cutting be done toward the stock and that the material be clamped and supported.

The removal of dust and chips, and the cooling of the tools

and the machined piece diverge from standard practice. That is, oil coolants cannot be used, and a vacuum system is best for removing dust. An air blast directed on the cutting tool serves as a coolant and also moves the chips into the nozzle of the vacuum system. Water can be used as a cooling agent, it is in fact a better coolant than air. However, it must be applied in volume, flooding the tool to prevent its combining with the fine dust and setting into a hard cake.

In this machining work cutting speeds must be reduced in order to prevent excessive heat and tool wear. Carbide- or diamond-tipped tools should be used, tools having no lip and a negative rake.

Drilling[6]—Regular high-speed drills may be used satisfactorily in drilling holes up to $^{3}/_{16}$ in. in diameter. A cutting speed of 30 to 60 surface ft. per min. is suggested, with a feed ratio of 0.002 in. to 0.004 in. per revolution. Care must be taken to prevent splitting of the board when the drilling is parallel to the laminations. After the hole is started with a standard ground drill, a bottom drill with a slow speed should then be used.

Carbide-tipped drills specially designed for plastics should be used for drilling holes larger than $^{3}/_{16}$ inch. Where a high rate of heat cannot be reduced, solid Stellite drills are suggested. Large holes in thin laminates can be cut with a fly or gasket cutter or they may be sawed with a circular saw-tooth cutter. They also may be cut in a lathe, boring mill or milling machine.

Punching—Standard punch-press equipment is used with these laminates. The punch should be soft brass, slightly concave on the face, and should be a sheared fit. The minimum distance between the holes and the edge of the sheet should be three times the thickness of the sheet. Punched holes should not be any smaller in diameter than the thickness of the sheet.

Sawing—Standard metal-cutting band saws give best results. Hand metal-cutting saws may be used and abrasive saws are satisfactory for cutting out blocks. Some fabricators use stone working equipment, such as the dual-column cutting machine utilizing saw blades or abrasive wheels.

Grinding and sanding—The endless-belt type of sander is recommended, although a disk cylinder or drum sander can also be used.

Turning—Metal cutting lathes with carbide-tipped tools are used with speeds of 100 to 150 surface ft. per min. and a feed of 0.010 in. per revolution.

Tapping—Laminates must be clamped when the tapping is done parallel with the lamination, and the edges of the hole should be chamfered and supported. Water is a good tapping medium. High-speed nitrated and chromium-plated taps are best, and 3-fluted or 2-fluted spiral gun taps are recommended.

Milling, planing and shaping—Tungsten-carbide-tipped cutting tools should be used in all these operations. Tools must be set so that the cut is a shearing action from the surface of the work backward and down. Thin sheet laminates may be cut by hand or with foot-power square shears, such as those used for thin sheet metal.

In its earlier stages, this project involved the use of flat assemblies only. As more test data became available, it appeared that a diversity of applications was feasible. The fabrication of molded rods and tubing was attempted using 7 mils glass fabric impregnated with melamine resin. However, for tubing with a small I. D. (less than $^{3}/_{8}$ in.) the use of a thinner glass cloth is helpful. The heavier glass cloth impregnated with a melamine resin is stiff and difficult to wind on a small diameter mandrel. Rolled tubes produced from this material are still not satisfactory. When the impregnated fabric is passed over the heat roll to soften the resin and facilitate bonding in the rolling operation, the temperature of the hot roll is sufficiently elevated to further advance the polymerization of the resin, thus giving low bonding strengths.

When pressures are used in the final curing stage, this factor of further polymerization is not detrimental to the physical properties of the cured laminated rod or tubing. A somewhat higher flow percentage (*Please turn to page 190*)

[6] The more important phases of technique used in actual machining are covered in the paragraphs on drilling, punching, sawing, grinding, turning, tapping and milling, extracted from a report by Frank E. Allen, chief engineer, Research Dept., Owens-Corning Fiberglas Corp.

***9**—The white type glass fiber melamine laminate which incorporates the non-pyrolized glass fabric is here contrasted with the brown laminate which employs the heat-treated glass fabric. The streak of dirt on the white board indicates how much more easily this material is soiled.* **10**—*After 10-min. exposure to arcing produced by a potential of 60,000 volts, the laminated panel shows no tracking or other electrical deterioration*

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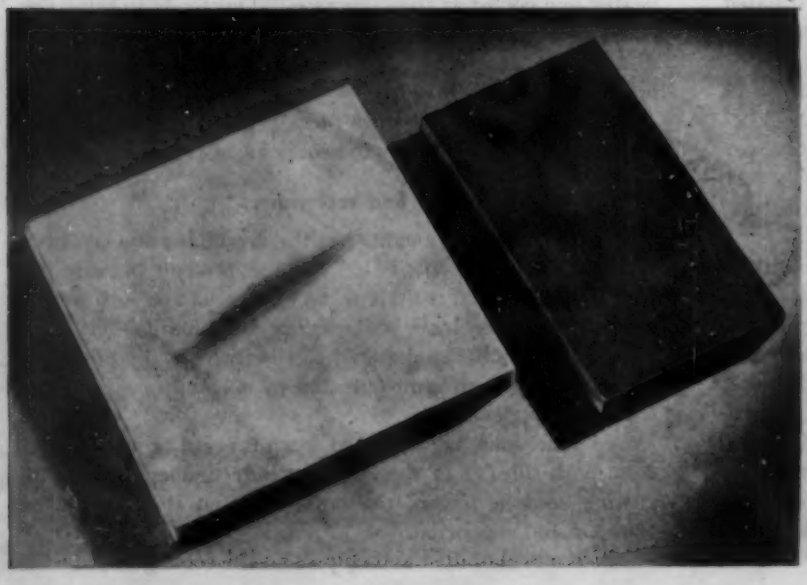

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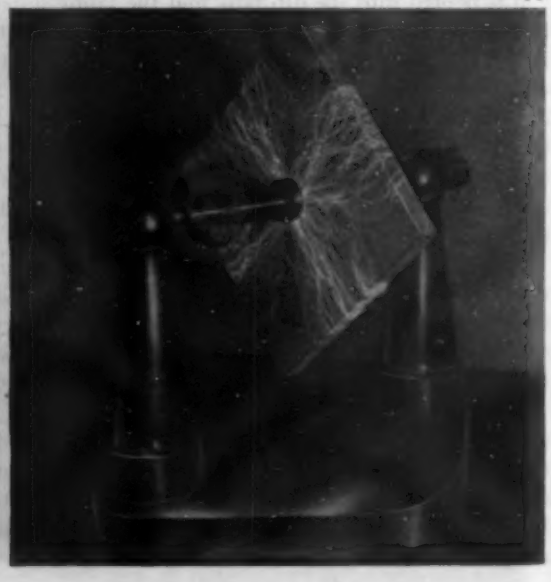


Tenite trim by Auburn Button Works, Inc., and Extruded Plastics, Inc. Megaphone by Merriman Bros., Inc.

navy trimmings

Rim, mouthpiece, and handle of the Navy megaphone are produced from black Tenite by extrusion and injection-molding. Extruded in a V-shaped profile, Tenite rim stock is coiled to shape while still plastic for convenient handling and assembly. When cut to lengths, it is slipped over the edge of the coated paper megaphone and cemented in place. The ends are bonded together with an acetone solution. The molded mouthpiece is also cemented; the molded handle is fastened to the side by rivets.

Tenite is extruded in a wide variety of strip, angle, and channel shapes. Available in all colors, it makes decorative as well as functional trim for furniture, wallboard, terrazzo flooring, and glass doors. Extruded in tubular form, this tough, virtually unbreakable plastic is proving suitable for many types of conduits, rollers, handles, and containers. To obtain further information about the uses of Tenite, write TENNESSEE EASTMAN CORPORATION (Subsidiary of Eastman Kodak Company), KINGSPORT, TENNESSEE.

TENITE

an Eastman Plastic


PLENTY TOUGH!
It takes a mighty strong plastic formulation to line up and hold a gang of heavy metal inserts in rigid position. To develop the required impact resistance and at the same time insure a trouble-free flow when transfer molding, the addition of fabric fragments to the general purpose phenolic enabled the part shown to perform a specific purpose assignment.
The right plastic needs the right fillers. Samples of our various strength-giving types and complete details upon request.
Inquiries invited.

TECHNICAL SECTION

DR. GORDON M. KLINE, Technical Editor

Short-time static tests and creep tests of a paper laminate*

by W. N. FINDLEY† and W. J. WORLEY†

HIGH-strength-paper laminates are among the recent developments in the plastics field which are of considerable interest as aircraft materials. These laminates, made from special Mitscherlich paper impregnated with special resins and molded at low pressures, are currently finding a number of applications in which the load-carrying characteristics of the material are important. Three examples of such applications are aircraft wing tips, ammunition boxes and fuselage sections. The tests reported in this paper were undertaken in order to provide needed information on the static strength and creep characteristics of this material.

The following tests were performed at a temperature of 77° F. and a relative humidity of 50 percent: static tension tests of specimens cut parallel and transverse to the grain of the paper; compression tests of specimens cut with the grain and across the grain; torsion tests of specimens with the long axis cut parallel to the grain of the paper; and creep tests at eight different values of stress under tension loading of specimens cut parallel to the grain. Values of compressive strength, yield strength and modulus of elasticity were obtained from all of the static tests. All static tests were conducted at nearly the same rate of tensile strain.

Several investigators have reported creep tests of both thermoplastic (1, 3, 4, 6, 7, 8)[1] and thermosetting types (2, 5, 9, 10, 11) of plastics. Most of the reported tests have covered only a very limited range of stress values and in many cases a limited duration—from 1 or 2 hr., in a few cases, to 1000 or 2000 hours. As far as the authors are aware, no creep tests of a Mitscherlich paper laminate have been reported.

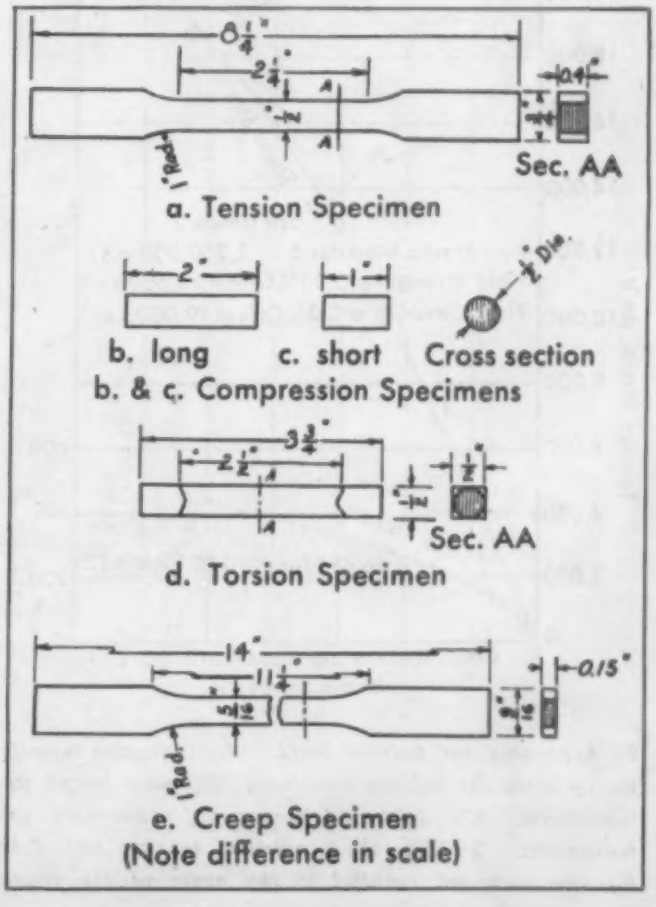
Material

The laminate for these tests was supplied by Taylor Fibre Co., in December 1942, and was made of high-strength Mitscherlich paper bonded with a low-pressure type of phenolic resin. The Mitscherlich paper was made from wood pulp by the sulfite process. It was manufactured by Wisconsin Water Power and Mfg. Co., and had the following characteristics:

Ream weight (480 sheets, 24 by 36 in.)	30.8 lb.
Thickness	3.3 points
Mullen test	30.3 p.s.i.
Gurley densometer test	20.4 sec.
Absorbency (5 min. in 16ths of an inch)	10.5
Tensile strength with the grain (1 in. wide)	32.3 p.s.i.
Tensile strength across the grain (1 in. wide)	11.6 p.s.i.

Bakelite Corp. manufactured the single-stage resin (BV-16-238) and the catalyst (BK-16-253) used in setting the resin. As received, the viscosity of the resin was 1389 centipioses at 80° F. For impregnating the paper the resin was mixed with a specially denatured alcohol. After the paper was impregnated, part of the volatile matter was driven off. The dif-

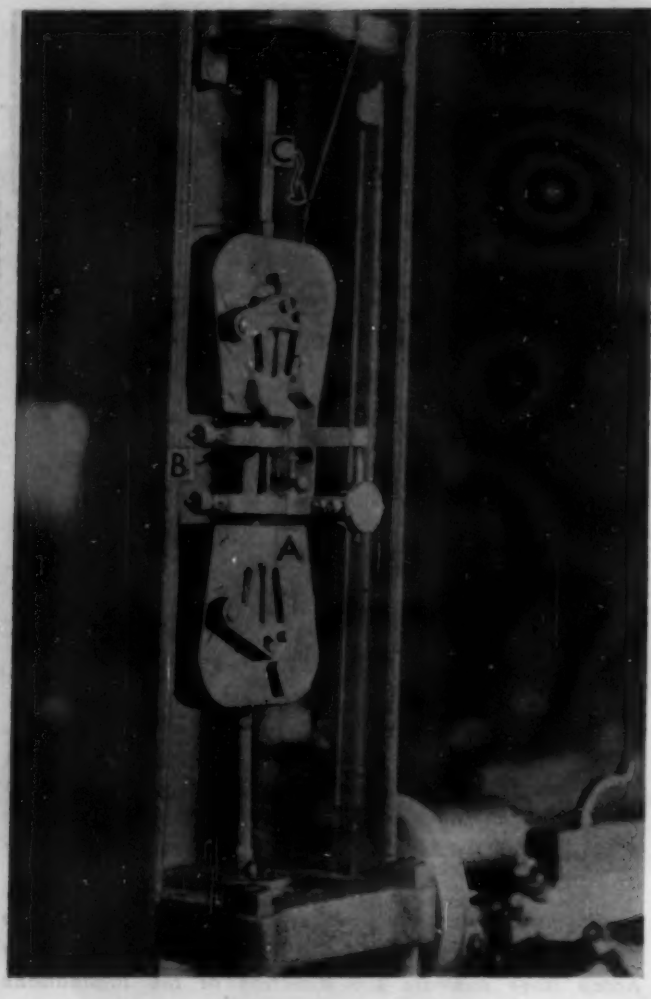
1—Specimens were machined from the laminated sheet to the measurements indicated in this drawing. The cross hatch lines indicate the direction of the laminations



* Presented at the 1944 Annual Meeting of the American Society for Testing Materials in New York and published here through the courtesy of that Society.

† Assistant professor and instructor, respectively, of Theoretical and Applied Mechanics, College of Engineering, University of Illinois.

[1] Numbers in parentheses refer to the reports and papers appearing in the list of references appended to this paper.



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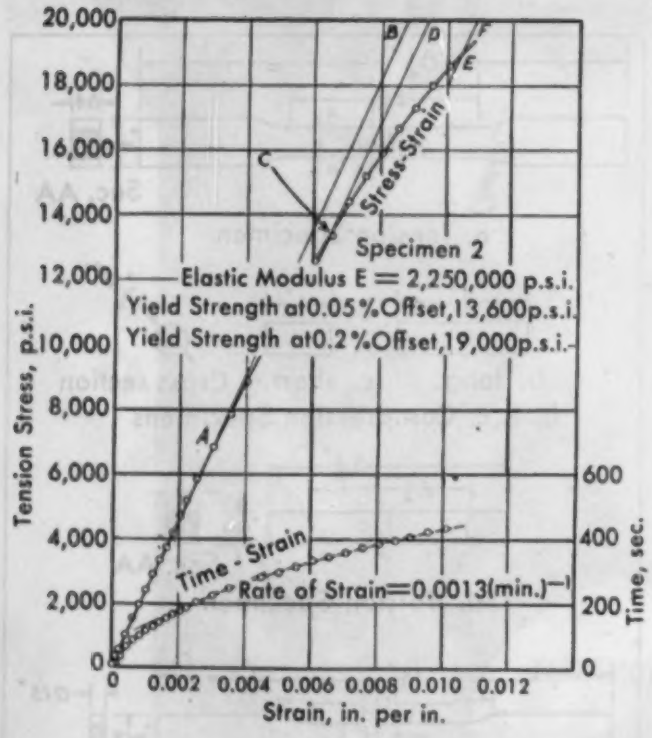

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2—Apparatus for tension tests. (A) indicates templin wedge grips for holding specimen; (B), gage length extensometer; (C), light coil spring for suspending extensometer. *3—This chart presents tension test data for specimen cut parallel to the grain of the paper*

ference between the use of this resin for low-pressure and high-pressure laminating was that less volatile matter was driven off when the paper was to be laminated at low pressure.

The laminate was supplied in a sheet 48 by 48 by 1/2 in. thick and was designated by the manufacturer as TV2 grade XMLP. The molding cycle consisted of 30 min. heating at a platen temperature of 325° F. and a pressure of 230 p.s.i. followed by 30 min. cooling. Grain direction of the paper was the same throughout the laminated sheet. The resin content of the laminate was 42 percent and the volatile matter was 1/2 of 1 percent, according to A.S.T.M. Standard D 229–43.[1]

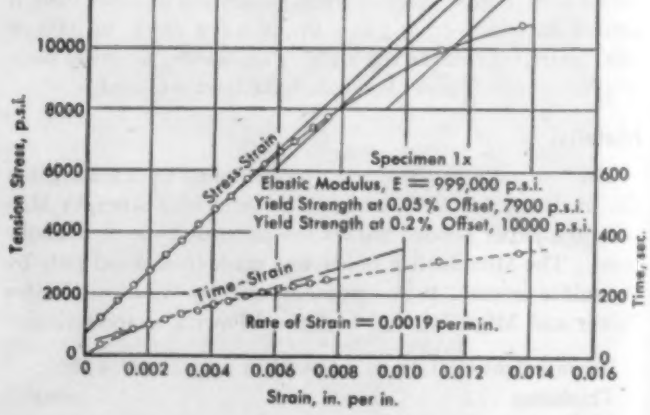
Specimens

The specimens used are shown in Fig. 1. The tension and compression specimens were machined from the sheet in each of two directions, one group with their axes parallel to the direction of the grain of the paper and one group with their axes perpendicular to the grain. The torsion and creep specimens were both cut from the sheet with their axes parallel to the grain. All specimens were cut from the sheet with their longitudinal axis parallel to the plane of the laminations. The tension specimens (Fig. 1*a*) were machined on a shaper to the dimensions shown. Half of the tension specimens were then altered by filing the minimum section at the center so as to produce a gradual taper from 0.50 in. wide at the ends of the gage section to 0.01 in. undersize at the center.

The compression specimens were turned on a lathe to the two lengths shown in Fig. 1*b* and *c*. The 2-in. specimen was used to obtain stress-strain relationships. The short specimen was used to obtain ultimate strength values only. The torsion specimens were also machined by turning in a lathe. Considerable difficulty was encountered in turning this laminated material for the torsion and compression specimens because of its tendency to chip when cutting against the laminations. This difficulty was minimized by using high cutting speeds and by frequent honing of the cutting tool.

The creep specimens (Fig. 1*c*) were cut from the original sheet with a milling cutter in such a manner that the flat side of the specimen was perpendicular to the plane of the sheet. The reduced section and radii at the end were formed on a shaper.

[1] See 1943 Supplement of Book of A.S.T.M. Standards, Part III, p. 64.



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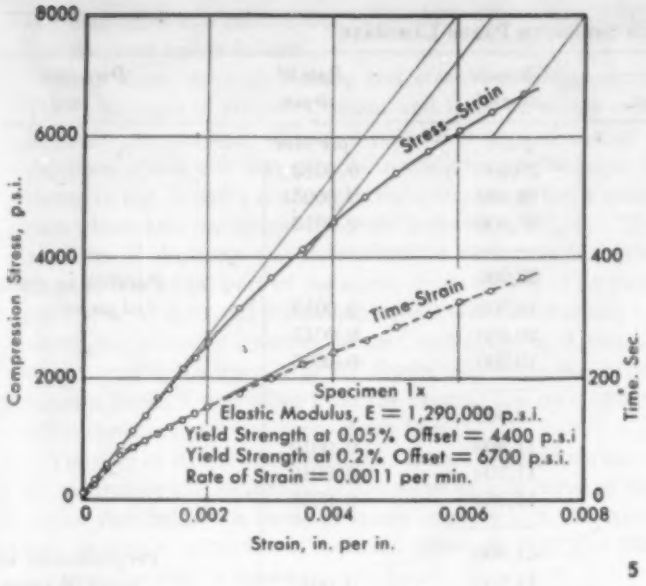
4—The tension test data obtained for a specimen whose axis was across the grain of the paper are shown in this diagram of stress versus strain and time versus strain. Modulus of elasticity was determined from the slope of the initial part of the stress-strain curve



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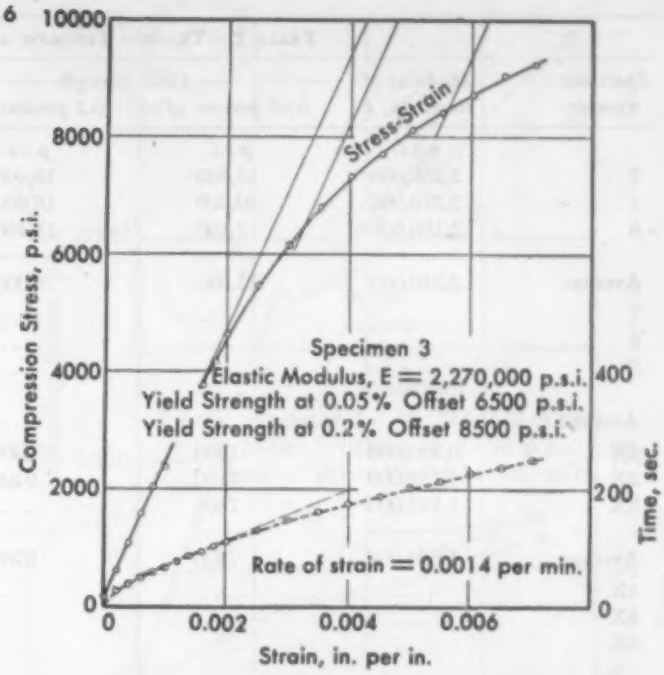
5—Compression test data are shown in this chart for a specimen which was cut across the grain of the paper



All specimens were finished by sanding with No. 3/0 emery paper. They were then placed in a room which was maintained at a constant temperature of 77 ± 1° F. and constant relative humidity of 50 ± 2 percent, and were allowed to remain in this room for at least two weeks before the tests.

Short-time tension tests

Short-time tension tests were performed on specimens as shown in Fig. 1*a*. These specimens were tested in tension on a 10,000-lb. 4-screw machine. This was a beam-weighing machine equipped with a separate variable speed drive. The specimens were held in Templin wedge grips (*A* in Fig. 2) mounted in such a way as to provide an axial load on the specimens. The strain of the specimen was measured by means of a Moore-Hayes 2-in. gage-length extensometer (*B* in Fig. 2). This instrument provided a multiplication such that one division on the dial indicated 0.0001 in. per in. strain in the specimen. In order to make it unnecessary for the specimen to support the weight of the extensometer and to prevent damage to the instrument if the specimen should fracture while the extensometer was attached, the latter was suspended by means of the light coil spring *C* shown in Fig. 2.

Tension tests were performed to determine the tension properties of the material in two directions—parallel and perpendicular to the grain of the paper. Two sets of tension tests were run for each direction—one in which the stress-strain characteristics were determined and another in which only the ultimate strength was obtained. In the former group the gage section of the specimen was straight, and readings of load, deformation and time were obtained simultaneously throughout the duration of the test. In the latter case only the load at fracture was recorded. For this latter purpose those specimens were used whose widths were reduced at the center to 0.01 in. less than at the ends of the test sections. This reduction in width was found necessary in order to cause the specimen to fail at the middle of the test section. Straight specimens failed at the shoulder as a result of the stress concentration at the fillet.

A preliminary test was made to determine the rate of testing speed required to produce a rate of tensile strain of about 0.0016 in. per in. per minute. All succeeding tests were run

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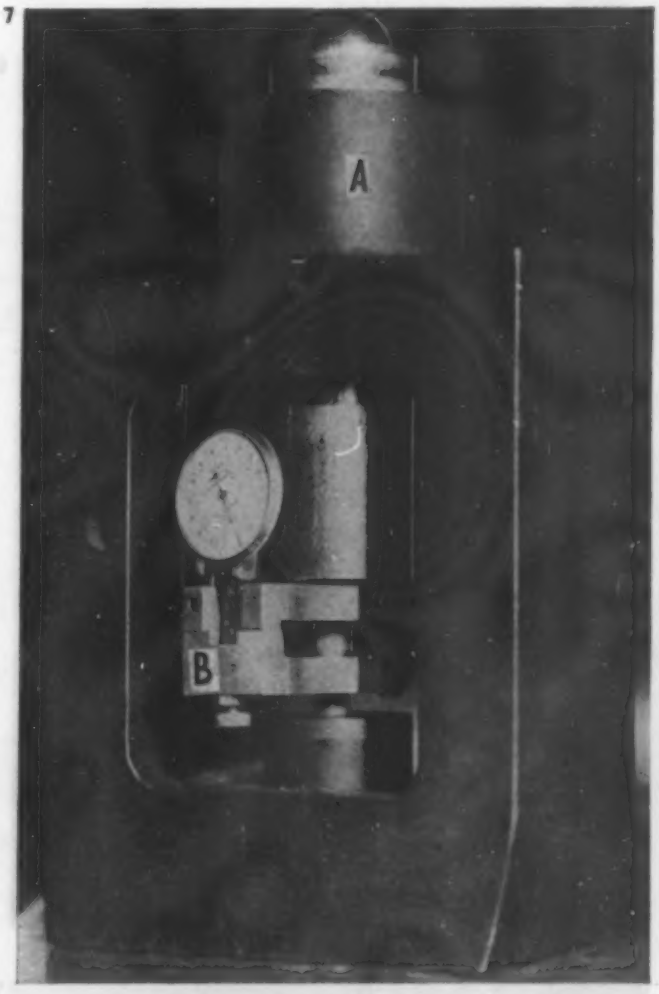

6—Data obtained in a compression test of a specimen cut parallel to the grain of the paper are diagrammed here.
7—In this apparatus, used for compression tests, (A) indicates the compression tool used to minimize the effect of possible eccentric loading and (B) indicates the compressometer which was used for determining strain

TABLE I.—TENSION TESTS ON A HIGH-STRENGTH PAPER LAMINATE

Specimen number	Modulus of elasticity, E	Yield strength		Ultimate strength	Rate of strain	Direction of load
		0.05 percent offset	0.2 percent offset			
	p.s.i.	p.s.i.	p.s.i.	p.s.i.	per min.	
2	2,250,000	13,600	19,000	20,400	0.0013	
4	2,270,000	10,300	16,600	19,400	0.00051	
5	2,190,000	12,100	18,400	20,300	0.0013	
Average	2,240,000	12,000	18,000	20,000		Parallel to grain of paper
1	....	....	....	19,500	0.0013	
3	....	....	....	20,200	0.0013	
6	....	....	....	19,200	0.0013	
Average	....	....	....	19,600		
1X	0,990,000	7900	10,000	11,800	0.0019	
2X	1,110,000	7100	9400	11,700	0.0012	
3X	1,140,000	7500	....	12,100	0.0013	
Average	1,080,000	7500	9700	11,900		Perpendicular to grain of paper
4X	....	....	....	11,700	0.0013	
5X	....	....	....	11,600	0.0013	
6X	....	....	....	12,000	0.0013	
Average	....	....	....	11,800		

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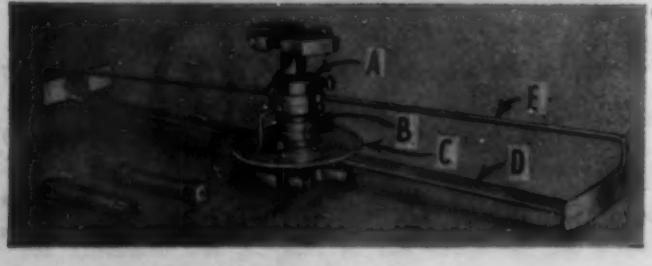


9

at or near this rate of strain, which had been selected to permit correlation between the results of these tests and tests performed by the authors on other materials. It corresponds roughly to the rate of strain produced by testing machines operated at a head speed of 0.05 in. per minute. However, it should be noticed that different machines, and even different materials tested in the same machine at the same rate of cross-head motion, will not in general produce the same rate of strain in the specimen. This is because of differences in the relative stiffness of the machine, the specimen and the auxiliary gripping apparatus.

The rate of strain, rather than the rate of increase of stress as used by some investigators, was made the same in these tests because the same rate of strain can be used without difficulty in testing materials which differ widely in modulus of elasticity. If such materials are tested at the same rate of stressing, the required testing machine speeds become excessive for materials of low modulus, and the rate of strain becomes too high to follow with ordinary equipment.

Both the tension tests and the compression tests were performed outside of the air-conditioned laboratory. The temperature of the testing room was about 75° F. and the relative humidity was variable. In order to minimize the effect of possible differences in temperature and relative humidity, the specimens were placed in an insulated box during the time the specimen was being transferred from the conditioned laboratory to the testing machine and the tests were conducted within 5 to 10 min. after the specimen was removed from the insulated box. During the test, readings of load, deformation and time were recorded up to a load within a few percent of

***8**—In this torsion-testing machine, a pendulum-weighing system consisting of a twisting head (A), a special chuck (B) attached to the shaft of this head and a second chuck (C) attached to the axis of the pendulum (D), is used as a torque measuring device. **9**—A detrusion gage with 2 rings (A), a removable spacer (B), a circular scale (C), 2 10-in. arms (D), and adjustable pointers (E), used in measuring angle of twist in torsion*

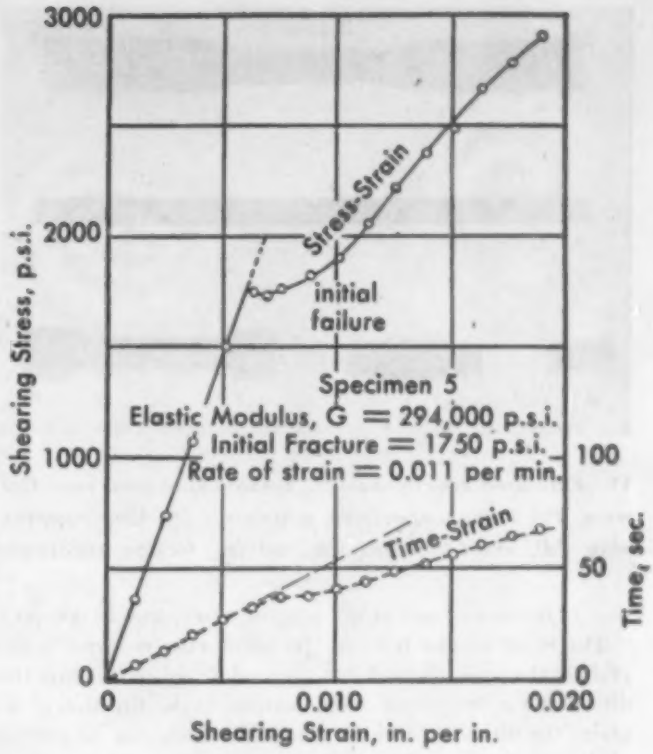
the load at which failure was expected. The extensometer was removed before failure.

From these data the stress and strain were computed. Then diagrams of stress vs. strain and time vs. strain were plotted. An example of such a plot for a tension test of a specimen whose axis was parallel to the grain of the paper is shown in Fig. 3, and a similar plot for a tension test of a specimen whose axis was across the grain is shown in Fig. 4. The modulus of elasticity was determined in each case from the slope of the initial part of the stress-strain curve. The yield strengths[1] at 0.05 and 0.2 percent offset were determined by noting the values of stress at points *C* and *E* in Fig. 3, respectively, at which a line *CD* or *EF* drawn parallel to the initial tangent line *AB*, and offset from the tangent line by 0.05 and 0.2 percent, crossed the stress-strain line.

The rate of strain was determined from a time-strain curve by measuring the reciprocal of the slope of this curve in the region just below the value of strain above which the stress was no longer proportional to strain (point *A*, Fig. 3). The tangent line used is shown in each figure.

Results of the tension tests are shown in Table I. The average value of the modulus of elasticity parallel to the paper grain was found to be 2,240,000 p.s.i. No significant difference was observed between the strengths determined with the two different types of specimens. The ultimate strength of the straight specimens averaged 20,000 p.s.i., and the ultimate strength as obtained from the tapered specimens averaged 19,600 p.s.i. The average yield strength at 0.05 percent offset

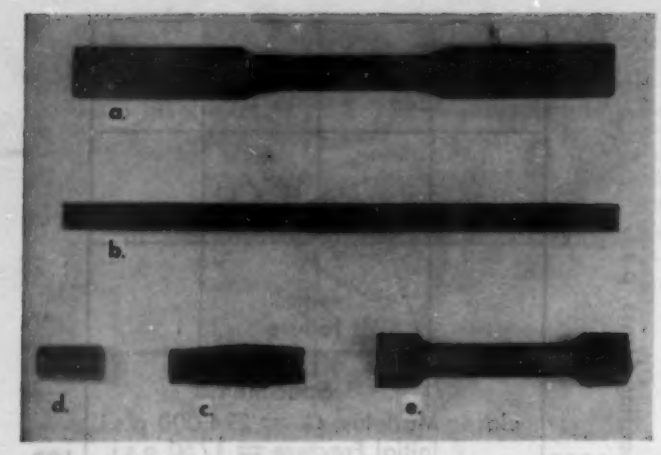
[1] See A.S.T.M. Standard Definitions of Terms Relating to Methods of Testing (E–6–36) 1942 Book of A.S.T.M. Standards, Part III, p. 849.



10—Torsion test data for a specimen cut parallel to the grain of the paper are shown graphically in this chart

TABLE II.—COMPRESSION TESTS ON A HIGH-STRENGTH PAPER LAMINATE

Specimen number	*Modulus of Elasticity, E*	*Yield strength* — *0.05 percent offset*	*Yield strength* — *0.2 percent offset*	*Ultimate strength*	*Rate of strain*	*Direction of load*
	p.s.i.	*p.s.i.*	*p.s.i.*	*p.s.i.*	*per min.*	
2 in. long						
1	2,370,000	7300	9200	19,600	0.0031	
2	2,360,000	6600	8600	....	0.0015	
3	2,270,000	6500	8500	....	0.0014	
5	2,220,000	6400	8400	....	0.0014	
6	2,220,000	7100	8800	....	0.0015	Parallel to grain of paper
Average	2,290,000	6800	8700			
1 in. long						
1′	....	....	....	17,800	0.0022	
2′	....	....	....	17,500	0.0022	
3′	....	....	....	17,900	0.0022	
4′	....	....	....	17,600	0.0022	
Average				17,700		
2 in. long						
1X	1,290,000	4400	6700	....	0.0011	
2X	1,280,000	4800	7000	16,200	0.0015	
3X	1,250,000	4800	7200	15,500	0.0015	
5X	1,290,000	4700	7000	15,000	0.0015	
6X	1,340,000	4500	6800	15,200	0.0015	
Average	1,290,000	4600	6900	15,500		Perpendicular to grain of paper
1 in. long						
1X′	....	....	....	14,400	0.0015	
2X′	....	....	....	14,300	0.0015	
3X′	....	....	....	13,800	0.0015	
4X′	....	....	....	13,800	0.0015	
5X′	....	....	....	15,500	0.0015	
Average	....	....	....	14,400		



11—Fractured specimens: (a), tension specimen seen flatwise; (b), tension specimen, edgewise; (c), long compression, (d), short compression and (e), torsion specimens

was 12,000 p.s.i., and at 0.2 percent offset, was 18,000 p.s.i.

The result of the tests of specimens cut crosswise of the grain of the paper showed that the modulus of elasticity in this direction was 48 percent of the modulus in the direction of the grain, the ultimate strength across the grain was 60 percent of the tensile strength with the grain, and the yield strengths at 0.05 and 0.2 percent offset were 63 and 54 percent, respectively, of the values which were obtained from tests parallel to the paper grain.

Short-time compression tests

Short-time compression tests were performed to determine the compression properties in the same two directions as the tension tests, namely, parallel and perpendicular to the grain of the paper. Compression specimens were tested in the same machine as the tension specimens, and under the same temperature and humidity conditions. In order to minimize the effect of possible eccentric loading, the compression specimens were tested by using a compression tool (*A*, Fig. 7) placed between the platen of the testing machine and the loading head. A compressometer (*B* in Fig. 7) of one to one ratio having a 0.0001-in. dial gage and 1-in. gage length was used to determine the strain. As in the case of the tension tests, the instrument was supported during the testing on a light coil spring.

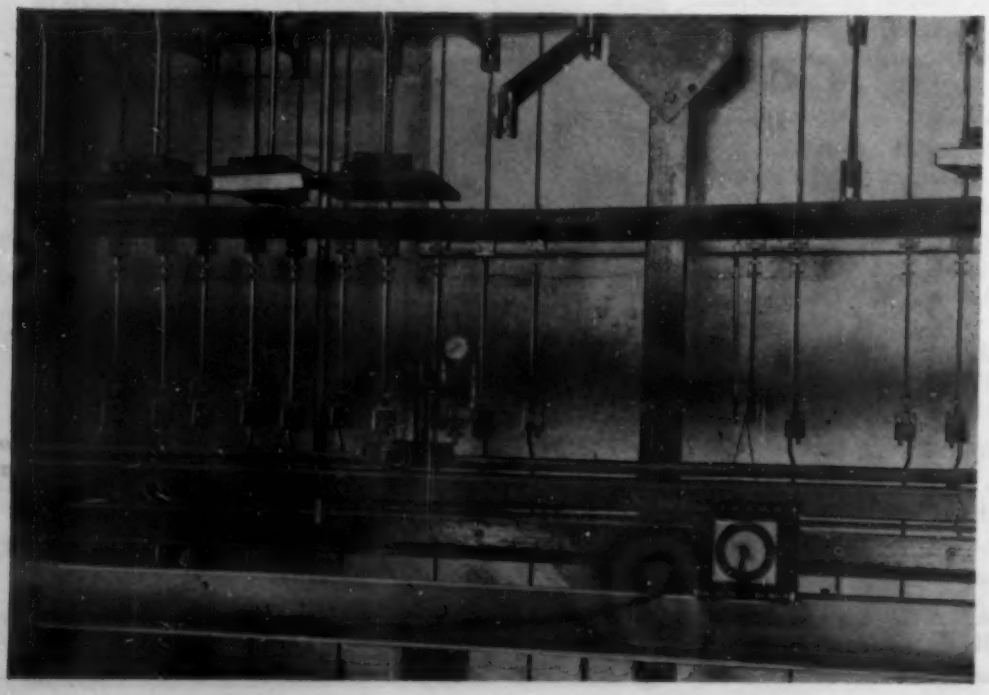
Two different shapes of specimen were required, one to determine stress-strain relations and another for the ultimate strength tests. These specimens are shown in Fig. 1. The 2-in. specimen ($l/r = 16$)[4] was used with the 1-in. gage length compressometer to determine the stress-strain relations. The 1-in. specimen ($l/r = 8$) was used to find compressive strength.

During the compression tests of the 2-in. specimens, readings of load, deformation and time were recorded. From these data the stress and strain were computed, and diagrams of stress vs. strain and time vs. strain were plotted. Figure 6 shows these two curves for a compression test of a specimen cut parallel to the grain of the paper, and Fig. 5 shows the same two curves for a specimen cut crosswise of the grain. The modulus of elasticity, yield strength at 0.05 and 0.2 percent offset and the rate of strain were determined from these curves in the same manner as described for the tension tests.

Results of the compression tests are shown in Table II. The average value of the modulus of elasticity with the grain of the paper was 2,290,000 p.s.i. The compressive strength, as measured from the short specimens, was 17,700 p.s.i. One of the long specimens was tested to failure at 19,600 p.s.i. No satisfactory explanation has been found for this higher strength—lower strength was expected because of column action. The small variation in temperature which may have existed was not enough to produce such a large change, nor was it likely that the difference in rate of strain would produce as much effect as noted. The rate of strain in the 1-in. specimens was determined by comparing the loading rate with the loading rate in a 2-in. specimen.

The result of tests of specimens cut crosswise of the grain of the paper show that the modulus of elasticity in this direction was 56 percent of that parallel to the grain, the compressive strength across the grain was 81 percent of the strength with the grain, and the yield strengths at 0.05 and 0.2 percent offset were 68 percent and 79 percent, respectively, of the lengthwise test values.

[4] l/r is the ratio of the length of the specimen to the radius of gyration of the cross section of the specimen.



12—A steel rack used for long-time tension creep tests, with loading levers, specimens, extensometers and auxiliary equipment. Twenty-two specimens can be suspended from this rack simultaneously

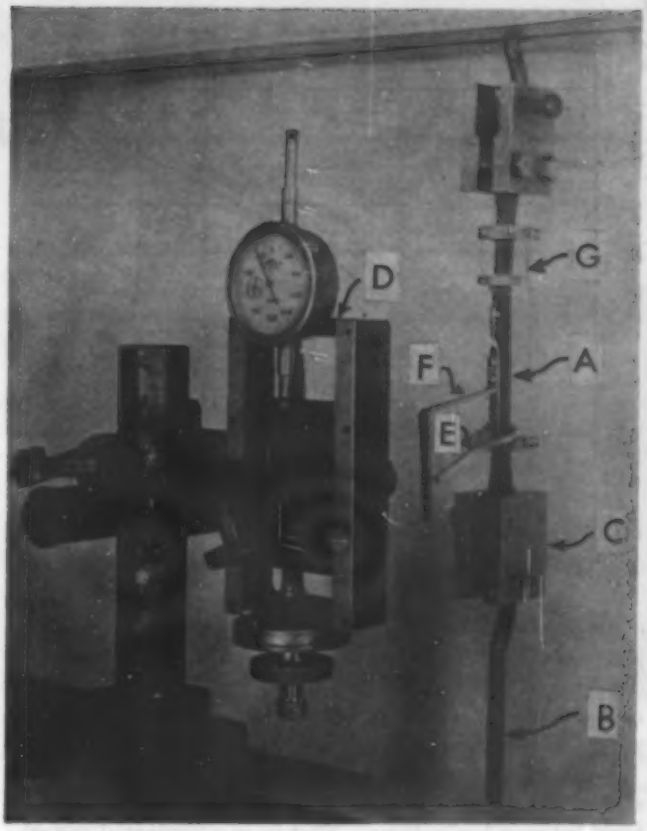
Short-time torsion tests

The special torsion testing machine used for these tests is shown in Fig. 8. The machine was constructed as an attachment for a low-capacity tension testing machine. The pendulum-weighing system of the tension testing machine was used as the torque measuring device for the torsion machine. This was accomplished by attaching to the tension machine a twisting head (*A*, Fig. 8) driven by a double worm drive. A special chuck *B* was attached to the shaft of this twisting head and another chuck *C* to the axis of the pendulum *D*. These chucks were designed to apply a torque to the specimen with little danger of bending the specimen at the same time. This action was further assisted by mounting the specimen on centers and applying the torque as a couple by means of adjustable screws.

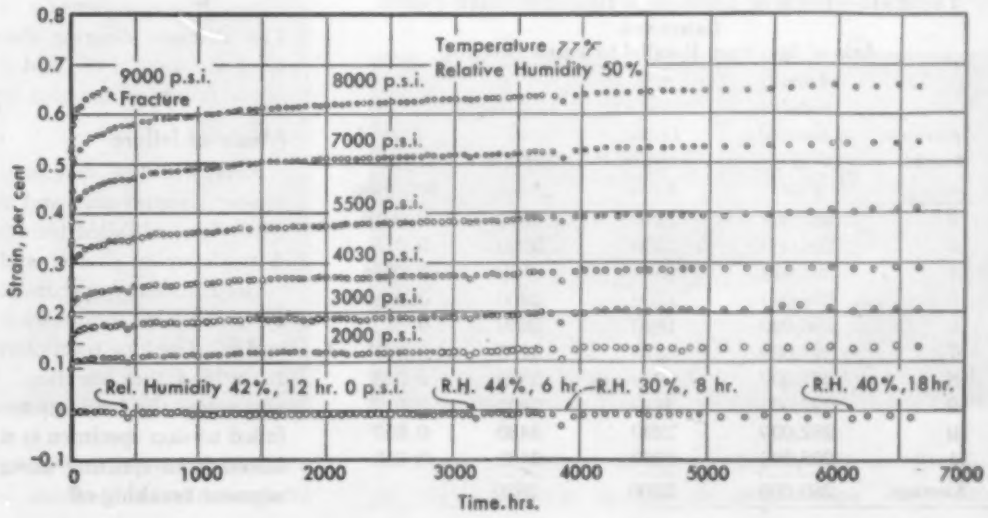
The gage used for measuring the shearing strain is shown in Fig. 9. It was designed to accommodate materials whose ultimate shearing strain was relatively small and also materials which might twist two or three revolutions in a length of 2 inches. The instrument consisted of two rings (*A*, Fig. 9) which were slipped over the specimen and fastened to it by three adjusting screws in each ring. A gage length of 2-in. was obtained by use of a removable spacer *B*. To one of the rings was fastened a circular scale *C* for measuring large angles of twist. Two 10-in. arms *O* fastened to the same ring carry scales on the end which were used to measure small shearing strain. Adjustable pointers *E* were attached to the other ring so as to indicate the readings on their respective scales.

Torsion tests differ from tension and compression tests in two important respects. They differ in respect to the state of stress developed and in respect to the stress gradient. The state of stress may be defined in terms of the ratio $\sigma_{max.}/\tau_{max.}$, that is, the ratio of the maximum tensile stress to the maximum shearing stress at a point in a stressed member. In a tension member this ratio is 2, while in a torsion member it is 1. Thus some materials may behave much differently in the two types of tests. The stress gradient is a measure of the distribution of stress over the cross section of a member. It has a value of 0 in a tension member, but can never be 0 in a torsion member. The magnitude of the stress gradient in a torsion member depends on the stress and the diameter of the member. The measured strength of a material may be influenced by the stress gradient so that this factor may also produce different results in the tension test and the torsion test.

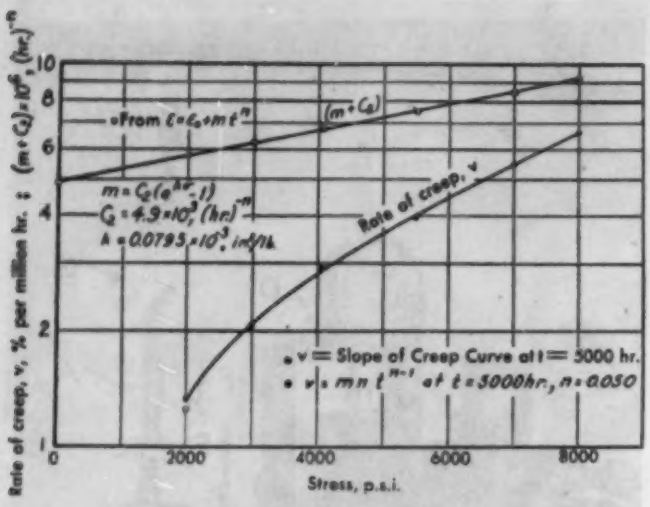
Laminated materials such as the Mitscherlich paper plastic reported herein are anisotropic; that is, their properties are not the same in all directions. In the tension and compression specimens cut with their axis parallel to the lamination, the maximum tensile stress is in the same direction throughout the test specimen. However, in a torsion specimen cut with its axes parallel to the lamination, both the tension and the shearing stresses have different directions (relative to the axes of the laminated sheet) at different points around the circumference of the specimen. Thus the equations for stress and strain for torsion of an isotropic member cannot be expected to indicate accurately the stress or strain in this anisotropic material. Nevertheless, the following



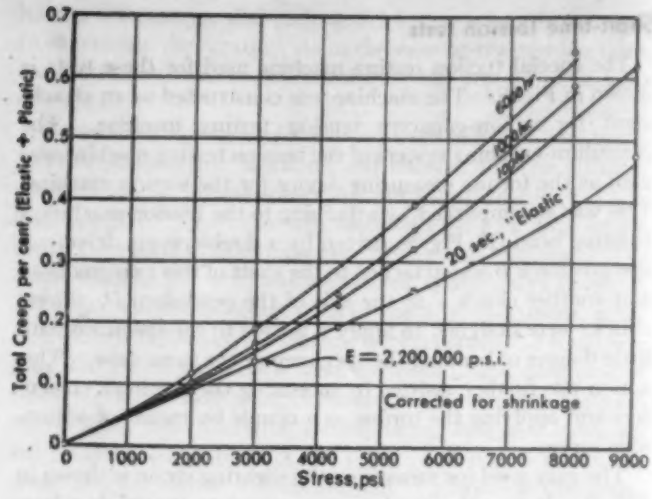
13—*Creep measuring apparatus. In this figure, (A) is the specimen; (B), the rod (C), the grips; (D), lever-type instrument with traveling microscope; (E), the lever; (F), a stationary arm and (G), a spring clip*



14—*A graphic plotting of creep versus time for the tension creep tests at constant load. The effect of short interruptions in humidity control is evident in all of the curves shown*



15—*Diagram showing effect of stress on rate of creep and $(m + C_3)$. Open circles indicate creep rate obtained*



16—*The effect of stress on the total creep for four different time intervals is indicated in this chart*

equations developed for isotropic materials were used here to give nominal values of shearing stress and strain as a basis for comparison. The equation for shearing stress in a circular member of an isotropic material subjected to torsion is $\tau = Tc/J$ and the equation for shearing strain is $\gamma = c\theta/l$.

In the case of a laminated material, the torsion test may serve as an indication of the relative shearing strength of the bond between laminations. That is, in a laminated material failure is most likely to take place by shearing parallel to the laminations.

Short-time torsion tests were performed on specimens (Fig. 1*d*) cut from the sheet with their longitudinal axis parallel to the grain. In order to provide comparable conditions between tension, compression and torsion tests, it was found desirable to have equal rates of strain for all tests. Therefore, to accomplish this, the rate of tensile strain was kept as nearly the same as possible in all three types of tests. In a circular torsion member the maximum tensile stress occurring at a point acts on a plane at 45° to the plane of the maximum shearing stress and is equal to the maximum shearing stress. Hence, the shearing rate of strain can be computed from the tensile rate of strain by the relation $d\gamma/dt = E/G \cdot de/dt$ where $d\gamma/dt$ is the shearing rate of strain, de/dt is the tensile rate of strain, and E/G is the ratio of tensile modulus of elasticity to shearing modulus. This equation also is inexact owing to the anisotropic character of the material. The required rate of strain was determined from the value of G determined in a preliminary test. The resulting shearing rate of strain required was 0.012 per min. which was rather fast owing to the low value of G. Thus it was possible to obtain relatively few test points in elastic range at this rate of test.

During the torsion test simultaneous readings of torque, angle of twist and time were recorded. The nominal shearing stress at the surface of the cylindrical specimen and the nominal shearing strain were computed from the relationship given above.

Curves of shearing stress vs. shearing strain and time vs. shearing strain were then plotted as in Fig. 10. The shearing modulus of elasticity G and rate of shearing strain were determined as in the case of tension tests. The torsion tests differed from the tension and compression tests in regard to shape of stress-strain curve. In the torsion tests, the stress increased as a linear function of strain up to a certain point at which initial failure or structural damage took place, that is, large increase in strain took place at nearly constant stress. The torque was then increased more gradually to a maximum value at which more general damage or failure took place by splitting parallel to the laminations. For the torsion test, the value of stress at which the initial failure took place was reported rather than a yield strength corresponding to a specified offset.

The results of torsion tests are tabulated in Table III. The average value of the modulus of elasticity in shear as determined from equations for isotropic material was 289,000 p.s.i. The ultimate shearing strength (modulus of rupture in torsion) was 2820 p.s.i., and the average shearing stress at the initial failure of the glue bond was 2200 p.s.i.

TABLE III—TORSION TESTS ON A HIGH-STRENGTH PAPER LAMINATE
Axis of Specimen Parallel to Paper Grain

Specimen number	*Shearing modulus of elasticity, G p.s.i.*	*Stress at Initial fracture p.s.i.*	*Modulus of rupture p.s.i.*	*Rate of strain per min.*
2	285,000	2240	3000	0.0016
3	295,000	2550	3000	0.015
4	294,000	2540	3120	0.0064
5	294,000	1750	2900	0.011
6	296,000	1890	3050	0.012
7	291,000	2370	3170	0.011
8	272,000	1960	2580	0.013
9	292,000	2140	2400	0.013
10	282,000	2290	2480	0.013
11	292,000	2260	2460	0.013
Average	289,000	2200	2820	

Mode of failure

Representative fractured specimens from the short-time tension, compression and torsion tests are shown in Fig. 11. Two views of failed tension specimens, *a* and *b*, are shown. A tendency to shatter and split along the laminations was noticed in many specimens. Characteristic failures of both 2-in. and 1-in. compression specimens are shown in Fig. 11*c* and *d*. The long specimens tended to fail by splitting parallel to the load, then buckling. The short specimens failed diagonally across the laminations on planes of maximum shear. A failed torsion specimen is shown in Fig. 11*e*. This failure resulted from splitting along laminations with occasionally a segment breaking off. (*Please turn to page 190*)

Preparation of test specimens with a diamond-impregnated cutting wheel

by FRANK W. REINHART*

ONE of the problems encountered in obtaining engineering data for the various types of glass-fabric laminates and mineral-filled plastics is the preparation of satisfactory test specimens. Not only are these materials difficult to machine but, in addition, there is a lack of skilled machinists needed to make good test specimens. Furthermore, the cost of machining these test specimens is high. A technique is described in this paper for making test specimens of these materials which does not require the services of a skilled machinist and consumes less time—hence is less expensive than the usual machining process.

Experience in the Organic Plastics Laboratory at the National Bureau of Standards has indicated that the diamond-impregnated cutting wheel[1] is suitable for preparing test specimens of glass- and mineral-filled plastics, all thermosetting plastics and a few thermoplastics.

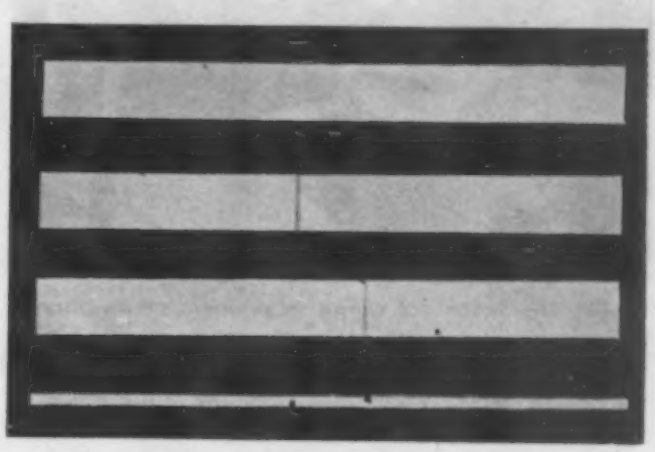
This cutting wheel was originally developed for cutting quartz, glass, tile, ceramics and all hard, brittle materials. It is made of a copper or steel plate which has diamond dust cemented in slots cut in the outer edges, and has an operating speed of 4000 to 4500 ft. per min. on the periphery. A stream of water is used for cooling; the flow is approximately 20 gal. per hour. The wheel is not satisfactory, however, for cutting metals, some thermoplastics, rubber and soft materials.

It is practically impossible for an operator to be injured by the cutting edge of the machine; a finger may be held against the wheel while it is running without producing a cut or scratch. The machine used in this laboratory (Fig. 1) has a movable bed plate on which the material to be cut is laid. The rotating wheel is clamped in one position, the height of

* National Bureau of Standards.

[1] These cutting wheels are made by the following manufacturers: the Carborundum Co., Felker Manufacturing Co. and Anton Smit and Co. The Felker wheels are sold under the name of "Di-Met Rimlock" and the Smit wheels under the name of "Terra Kutter." The Felker Manufacturing Co. also makes machines for using the wheels, one of which is shown in Fig. 1.

1—Equipment used for the preparation of test specimens of laminated plastics with a diamond abrasive wheel

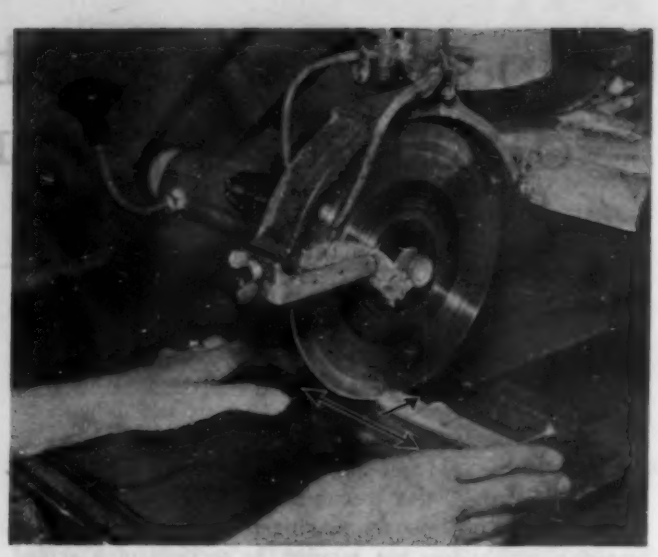


2—Three views of the completed tensile-shear specimen and the blank from which it is prepared. The specimen is grooved when it is pushed directly under the cutting wheel which has been elevated above the table

3—A clamping device for the preparation of the tensile specimens. The blanks are held on edge in the attachment which, in this case, is made from salvaged brass

4—Three specimens of tensile blanks are set in place in the clamping device, in preparation for cutting

5—The specimens are shown in position, preliminary to the cutting of a reduced section of tensile specimen



6—Cutting operation to produce reduced portion. Arrows indicate movements of clamping device holding specimen

the edge of the wheel being adjusted above or below the slot in the bed plate.

Cut edges of specimens made with this abrasive wheel are as good as and, in many cases, better than those made with milling cutters and grinding wheels. There are no evidences of delamination or decomposition of the cut plastic. Also, this method of cutting is faster than band saw cutting, milling or grinding. Simple straight cuts with this wheel are used for cutting up large sheets, for preparing flexure, compressive water-absorption, resin-content and density test specimens, and for making rectangular blanks for various purposes.

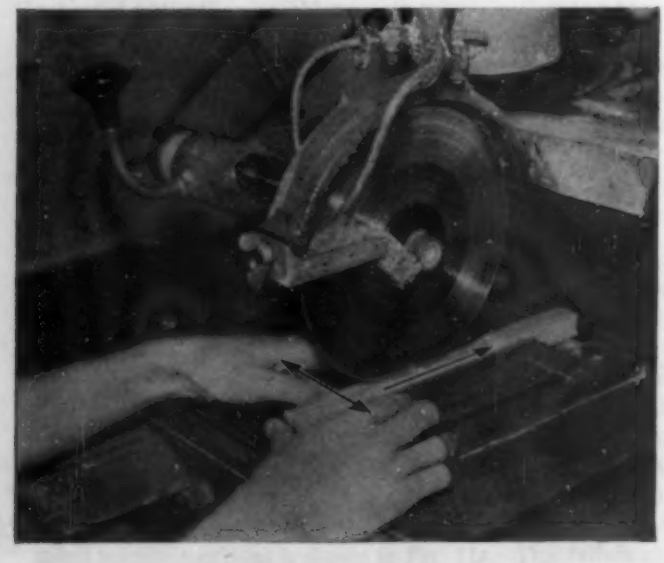
Using this machine, no difficulty is experienced in cutting the sides of an 8-in. long piece of plastic so that they are parallel to within 0.005 inch. With a little care and the proper technique, 8-in. long pieces can be so cut to within 0.001 inch Most of the difficulty in cutting more precisely with this particular machine is attributable to variations in the movement of the bed plate. Machines of greater precision are manufactured, but they are not large enough to be used for cutting most plastic test specimens. In cases where the precision of the machine shown in Fig. 1 is not adequate, it is used to cut the blanks for more precise machining, since carefully made blanks reduce the time required for milling or grinding.

Notched tensile-shear test specimens (plywood type) are being prepared with this machine. For this work, the cutting wheel is elevated above the table so that a groove is cut in a rectangular bar of plastic when it is pushed under the wheel. The blank and three views of the completed specimen are shown in Fig. 2.

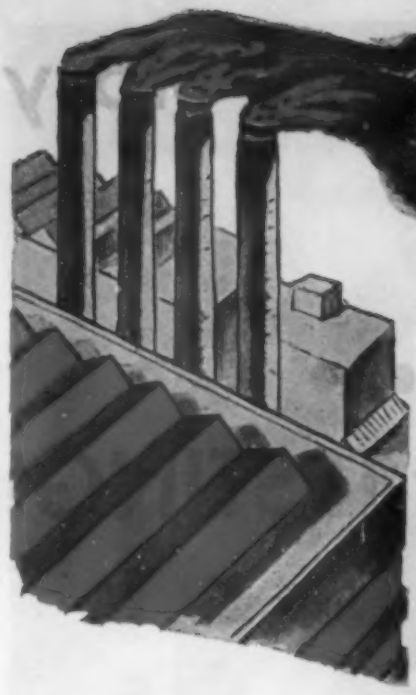
Preparation of tensile specimens

A technique has been developed whereby tensile specimens with a reduced section to meet the requirements of Method No. 1011 of Federal Specification L-P-406a are readily prepared. Rectangular blanks, approximately $^3/_4$-in. wide by 10 in. long by the thickness of the material, are first made ready. Lines are then drawn across the edges to indicate the desired position of the uniform reduced section and the tapered sections. The blanks are held on edge in a clamping device. Figure 3 shows a suitable unit of this type which was made from salvaged brass. The same device with three specimens in proper position is shown (*Continued on page 194*)

7—The tensile specimen is shown in position preparatory to the operation of cutting the tapered section



8—Specimen in process of being tapered. Arrows indicate directions of motion of clamping device holding part



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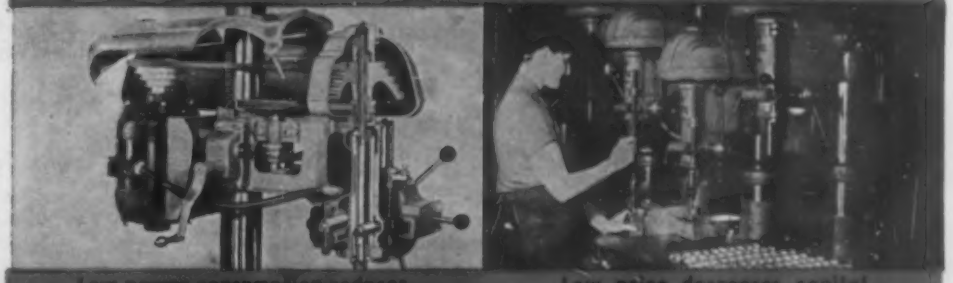

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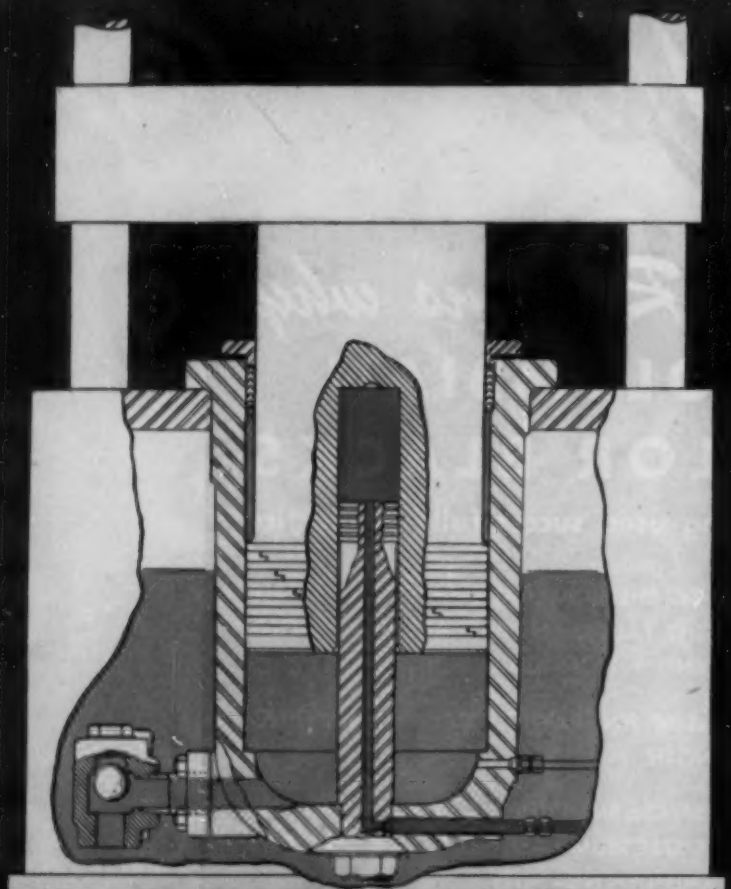

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TECHNICAL BRIEFS

Abstracts of articles on plastics in the world's scientific and engineering literature relating to properties and testing methods, or indicating significant trends and developments.

Engineering

DIELECTRIC HEATING. T. W. Dakin and R. W. Auxier. Ind. Eng. Chem. *37*, 268-275 (Mar. 1945). Some principles of dielectric heating and methods of applying dielectric measurement data to the solution of engineering problems in dielectric heating are outlined. Measurements of loss factor and dielectric constant in the radio-frequency range for some cellulose-filled laminating materials are presented. A few of the methods of quantitatively attacking the problem of dielectric heating are sketched.

Chemistry

GEL FORMATION IN ADDITION POLYMERIZATION. C. Walling. J. Am. Chem. Soc. *67*, 441-7 (Mar. 1945). Following Flory's method, an equation was developed predicting the gel-point in the addition polymerization of a mixture of mono- and bi-functional monomers. This equation is equivalent to that developed by Stockmayer. Gel-points for the systems methyl methacrylate—ethylene dimethacrylate and vinyl acetate—divinyl adipate, were determined under a variety of experimental conditions. Results are in reasonable agreement with the above equation only in the presence of 0.2 mole per cent or less of bifunctional monomer. Experimental results in the presence of more bifunctional monomer are explained qualitatively on the basis that the reaction mixture consists of discrete swollen polymer molecules, the rate of diffusion of which is slow compared with the rate of polymer chain growth. Employing a model based on this concept, it is calculated that gelation can only occur after these swollen molecules have filled 13 to 23 percent of the reaction mixture. Experimental results indicate 25 to 46 percent in fair agreement with calculation.

THEORY OF THE VISCOSITY OF SOLUTIONS OF MACROMOLECULAR SUBSTANCES—III. VISCOSITY AS A FUNCTION OF THE CONCENTRATION OF MACROMOLECULAR SUBSTANCES. J. J. Hermans. Kolloid-Z. *106*, 95-8 (1944); Chem. Abstracts *39*, 659 (Feb. 20, 1945). The lattice structure of the solutions of high polymers is discussed. An equation which shows that the average distance between lattice points is an inverse function of the concentration is derived. The mean relaxation time of lattice points which are formed by more than one molecule is high; this contributes to the rapid increase of viscosity with increase in concentration.

SYNTHETIC RESINS AND RUBBERS. P. O. Powers. Chem. & Eng. News *22*, 1992-3 (Nov. 25, 1944). A chart showing in graphic form the synthesis of resins and rubbers is given.

STATISTICAL THERMODYNAMICS OF HIGH-POLYMER SOLUTIONS—I. THEORY FOR DILUTE SOLUTIONS. T. Alfrey and P. Doty. J. Chem. Phys. *13*, 77-83 (Feb. 1945). Previous theoretical treatments of the thermodynamics of high-polymer solutions have assumed that the entropy of mixing is independent of the magnitude of the heat of mixing. The present treatment considers energy interactions on a molecular scale and includes these in the configurational partition function. This leads to the derivation of expressions for the heat of mixing and the entropy of mixing which reflect the effect of solvent-solute interaction. One result of particular interest is an exact expression for the temperature dependence of osmotic pressure.

THERMODYNAMICS OF HETEROGENEOUS POLYMERS AND THEIR SOLUTIONS. P. J. Flory, J. Chem. Phys. *12*, 425-38 (Nov. 1944). The statistical mechanical treatment previously applied to homogeneous polymer solutions has been extended to heterogeneous polymers composed of numerous molecular species differing in polymer chain length. Entropies of mixing with solvent are derived with reference to three standard states: the oriented pure components, the disoriented pure components and the disoriented mixture of species. The entropy of mixing with respect to the last-mentioned state is identical with that previously derived neglecting polymer heterogeneity. Upon introducing a van Laar heat of mixing term, expressions for the partial molal free energies are derived. These should be reasonably correct in view of the satisfactory agreement between observed solvent activities in polymer-solvent solutions and theory, as shown by Huggins. The relationships should be useful not only in dealing with solutions, but also in equilibria involving heterogeneous polymers in the absence of solvent. The thermodynamic equations are applied to the problem of equilibrium in the range of partial miscibility for solvent-heterogeneous polymer systems. The requisites for efficient fractionation of high polymers are discussed. The efficiency of separation depends on the ratio of the volumes of the supernatant and the precipitated phases. In order to attain a high value for this ratio, very dilute solutions must be employed. The higher the molecular weight at which separation occurs, the greater the dilution required for the same sharpness of separation. The free energy expressions are also applied to the formulation of equilibrium constants to be employed in reversible polymerization-degradation processes. Concentrations should be expressed in moles per unit volume in the equilibrium constant. The equilibrium state for a polyfunctional condensation, considered as a reaction between functional groups, is not affected by the polymeric nature of the reacting species; the position of equilibrium should be the same as is found for analogous monofunctional reactants under the same conditions.

ORIENTATION AND RUPTURE OF LINEAR MACROMOLECULES IN DILUTE SOLUTIONS UNDER THE INFLUENCE OF VISCOUS FLOW. J. Frenkel. Acta Physicochimica U. R. S. S. *19*, No. 1, 51-6 (1944). The Kuhn-Boeder theory of the rigid dumbbell molecules in a viscous flow of the Couette type is modified for the case of a steady irrotational viscous flow. The orientation effect due to such a flow can be described with the help of Boltzmann's formula, which under certain restrictions can be applied to the case of the Couette flow by referring the orientation of the molecules to a rotating coordinate system. There exists a critical velocity gradient, for which the molecules tend to be disrupted if their extension is proportional to the extending force. The theory is further generalized to the case of polymeric molecules which can be represented as a lace of spherical buds with free rotating and slightly extensible links. It is shown that the critical velocity gradient, corresponding to their kinetic elasticity, is relatively low and that the central portion of the molecule becomes straightened out along the direction of flow, as soon as it is reached, while the two end portions remain curled in the usual way. This corresponds to a nearly eight-fold decrease of the additional viscosity of the solution due to the presence of the macromolecules and accounts for the non-Newtonian behavior of such solutions. The extending forces acting on the molecular chain are largest at its center, and the limiting value of the

velocity gradient which can be resisted by the molecule without rupture is calculated. The results are applied to the explanation of the depolymerization of the molecules under the influence of ultrasonic vibrations.

EMULSION POLYMERIZATION OF ACRYLIC ESTERS. W. C. Mast, L. T. Smith and C. H. Fisher. Ind. Eng. Chem. *37*, 365-9 (Apr. 1945). Effects of various agents on the emulsion polymerization of acrylic esters are described and directions are given for preparing several types of resin emulsions. When emulsion polymerization is used merely to convert monomeric acrylic esters into polymers or copolymers of relatively high molecular weight, Tergitol Penetrant No. 4 and ammonium persulfate can be used satisfactorily as emulsifier and polymerization catalyst, respectively. The resulting emulsion is only moderately stable and can be coagulated readily by the addition of aqueous solutions of sodium chloride, acetic acid, or mixtures of the two. Triton K60 produce emulsions of only moderate stability. Emulsions remarkably stable to electrolytes (but not to mechanical agitation or solvents such as acetone and ethanol) can be made with Triton 720 as the emulsifier. Triton 720 and Tergitol Penetrant No. 4 can be used together in various proportions to produce emulsions of almost any desired stability to electrolytes. Stable emulsions suitable for brushing and spraying can be prepared with several combinations of agents. The viscosity of acrylic resin emulsions can be controlled over a wide range by using various quantities of ammonium alginate, modified casein and Tergitol Penetrant No. 4. Films obtained from these emulsions adhere well to smooth surfaces.

THE INTERACTION OF PLASTICIZERS AND POLYMERS. E. M. Frith. Trans. Faraday Soc. *41*, Part 2, 90-101 (Feb. 1945). The general problems of plasticizer compatibility are discussed and it is suggested that a comparative measure of the compatibility can be obtained from experiments which measure polymer-plasticizer interactions. Experiments are described which measure the viscosity of dilute polymer solutions in suitable mixed solvents containing the plasticizer in question. The effect of temperature and composition of the mixed solvent is also discussed. The experiments are considered in the light of a previous theory of the effect of solvent on the specific viscosity/concentration ratio. The results do not support the suggested view that the slope of the specific viscosity/concentration ratio vs. concentration curve is a simple linear function of the interaction /temperature ratio.

METHYL ACRYLATE BY PYROLYSIS OF METHYL ACETOXYPROPIONATE. W. P. Ratchford and C. H. Fisher. Ind. Eng. Chem. *37*, 382-7 (Apr. 1945). Methyl acrylate was made by pyrolyzing the acetyl derivative of methyl lactate in stainless steel equipment at various temperatures and pressures between 500 and 625° C. and 1 to 67 atmospheres. Moderate pressures had little effect, but lower yields of methyl acrylate were obtained at the higher pressures, primarily because of the formation of the dimer and higher polymers of methyl acrylate. Other by-products were formaldehyde, acetaldehyde, methyl acetate, carbonaceous material, oxides of carbon and gaseous hydrocarbons. High yields of methyl acrylate and acetic acid were obtained below 565° C. under approximately atmospheric pressure. The decomposition of the ester appears to be a reaction of the first order.

Properties

THE HEAT CAPACITY, HEAT OF SOLUTION AND CRYSTALLINITY OF POLYTHENE. H. C. Raine, R. B. Richards and H. Ryder. Trans. Faraday Soc. *41*, Part 2, 56-64 (Feb. 1945). The heat capacity of a sample of polythene over the range 20 to 165° C. and the heats of solution of samples in xylene at 78 to 95° C. were measured. The specific heat of solid polythene at 20° C. is about 0.55, and is greater than the specific heat of entirely crystalline short-chain paraffins. As the temperature is raised, the specific heat increases, reaching a value of about 1.0 at 90° C. and 2.0 at 110° C. These results indicate a disordering of the structure of the solid beginning below 50° C. and becoming increasingly marked as the temperature is raised, culminating in a relatively sharp change to a liquid structure at about 115° C. The difference between the heat capacity of solid polythene and the extrapolated heat capacity of liquid polythene at the same temperature (the heat of fusion) is 43.4 calories per gram at 20° C., decreasing to 28.7 at 90° C. and 9.6 at 110° C. Values for the heat of solution in xylene are similar to the heat of fusion at the same temperature. A comparison with the heat of fusion of entirely crystalline paraffins indicates that at room temperature the polythene sample whose heat capacity was measured was approximately 75 percent crystalline. Lack of complete reversibility of heat capacity measurement shows that thermodynamic equilibrium between crystalline and amorphous regions is not instantaneous.

MAGNETIC ANISOTROPY OF CERTAIN ORGANIC SUBSTANCES WITH A FIBROUS STRUCTURE. E. Cotton-Feytis and E. Fauré-Frémiet. Compt. rend. *214*, 996-8 (1942); Chem. Abstracts *39*, 234 (Jan. 20, 1945). Rubber exhibits magnetic anisotropy when subjected to mechanical deformation. The anisotropy is related to the parallel orientation of the chain molecules. Magnetic anisotropy is found in cellulose fibers and in protein fibers. Values of the magnetic anisotropy of various fibers are tabulated.

SOME PROPERTIES OF ROSIN. J. E. Hawkins. Proc. Florida Acad. Sci. *7*, 50-8 (1944). Specific rotations, densities, and apparent and partial specific volumes in benzene of rosins at 28, 33 and 38° C. are reported.

DIELECTRIC PROPERTIES OF LAC. G. N. Bhattacharya. Indian J. Physics *18*, 1-22 (1944). The dielectric properties of lac were investigated over the range 50 c./sec. to 500 kc./sec. and 20 to 110° C. The power factor increases rapidly above 40° C. to a maximum and then falls. The maximum point occurs at higher temperatures as the frequency is increased. It is concluded that only the hydroxyl groups rotate. There appears to be a second order transition point some place near 35° C.

MECHANISMS FOR THE RELAXATION THEORY OF VISCOSITY. D. D. Eley and D. C. Pepper. Nature *154*, 428 (1944). The theory applied by Powell and Eyring to explain the flow of solid-liquid disperse systems is not applicable to the flow of plasticized cellulose derivatives.

COMPARISON OF ABRASION RESISTANCE WITH OTHER PHYSICAL PROPERTIES. F. N. Upham. Trans. Inst. Rubber Ind. *20*, 101-2 (1944). The abrasion resistance of a vulcanized rubber reclaim composition filled with zinc oxide and clay is more sensitive to the degree of vulcanization than the hardness, T-50 value, elasticity and tensile strength are.

Testing

DETERMINATION OF MOISTURE-VAPOR TRANSMISSION OF PACKAGING MATERIALS. L. Boor and J. K. Dixon. Paper Trade J. *119*, No. 18, 26-34 (Nov. 25, 1944). The fluorescence in ultraviolet light is used to determine the uniformity of coatings on paper. This test is used to control the impermeability to water vapor of coated papers.

GAS TRANSMISSION MEASURED BY VOLUMETRIC METHOD. H. R. Todd. Modern Packaging *18*, 124-6, 160 (Dec. 1944). A simply constructed apparatus for measuring the transmission of gases through packaging materials is described. Although designed for testing the highly gas-proof plastic materials, the method could probably be adapted to the more porous papers by reducing the pressure differential on the two sides of the sheet. Triplicate determinations were con-

ducted on several materials. These checked within 8 percent when different pieces of the same sheet were used. Some excessively high values occurred with the very thin sheets (less than 0.002 in.) which were apparently due to the lack of uniformity and to the porosity of these thin films. The results were obtained in from 30 minutes for the most permeable films to 24 hours for the materials showing the slowest gas transmission. A constant temperature cabinet is essential for best operation, and changes in barometric pressure during each test must be taken into account in calculating the results. The procedure is a volumetric method. The air and carbon dioxide transmission rates of films of polyvinylidene chloride, regenerated cellulose, rubber hydrochloride, cellulose acetate, polyethylene and ethyl cellulose were determined. Dry regenerated cellulose has the lowest specific air transmission rate, and dry ethyl cellulose the highest. Moist polyvinylidene chloride film has the lowest specific carbon dioxide transmission rate and moist ethyl cellulose the highest.

WORKING PROPERTIES OF THERMOSETTING MATERIALS. K. Mehdorn. Kunststoff-Tech. u. Kunststoff-Anwend. *12*, 92-101 (1942); Chem. Abstracts *38*, 6424 (Nov. 20, 1944). Graphical methods of characterizing the flow of thermosetting plastics are analyzed. The most complete characterization is obtained by a three-dimensional diagram in which time of flow, distance of flow and temperature are considered.

COLOR TEST FOR OILS AND RESINS, USING HIRSCHSOHN REAGENT FOR CHOLESTEROL. H. C. Brinker. Ind. Eng. Chem. Anal. Ed. *17*, 130 (Feb. 1945). The color developed in contact with Hirschsohn reagent, 9 grams of trichloroacetic acid in 1 cc. of distilled water, may be used to identify various oils and resins. The colors given by 17 oils and 10 resins are reported.

MOISTURE DETERMINATION IN RESOLS. F. Feith. Kunststoffe *34*, No. 4, 71-6 (1944); Chem. Abstracts *38*, 6235 (Nov. 20, 1944). The customary methods of determining moisture content are discussed and shown to give unreliable results when applied to resols. The moisture content of resols can be determined to within 0.4 percent by a new method. The water is distilled off with isobutanol, and the water content of the mixture determined from the density. The first 100 ml. distilled from a solution of 50 to 100 g. of resol in 150 ml. of isobutanol contains all the water that was in the solution.

NOTES ON THE QUALITATIVE ANALYSIS OF VARNISHES FOR THE COMMONLY USED TYPES OF RESINS. Chicago Paint and Varnish Production Club. Am. Paint J. Convention—at Home Daily *29*, No. 5B, 18 (Oct. 31st, 1944). The color reaction of 12 resins commonly used in varnish formulations with sulfuric acid, acetic anhydride, uranyl nitrate, chloroform and antimony trichloride are used to identify the resins. The resins must be relatively pure. Results are reported in chart form.

Synthetic rubber

SOME PHYSICAL PROPERTIES OF ELASTOMERS AT LOW TEMPERATURE. H. E. Greene and D. L. Loughborough. J. Applied Phys. *16*, 3-7 (Jan. 1945). The effect of low temperatures on the elasticity of rubber is considered. Rubbers can be characterized by the temperature at which they become brittle and by the width of the transition region. The sharpness of the transition between the elastic and the glassy states is greatest when the testing time is long compared to the molecular relaxation times. Other physical factors such as sample shape, stress at which the modulus is calculated, and the previous history of the sample affect the absolute nature of the elastic properties measured. A test is described which gives the values of the elastic constants at slow rates of extension, at moderate extensions, on previously flexed samples. For these conditions the superiority of gum stocks at low temperature decreases in the order: polybutadiene, natural rubber, butyl, neoprene FR. The comparative values of the stocks can be changed by compounding variations. Addition of plasticizer shifts the relative modulus vs. temperature curve down the temperature scale without producing a significant change in shape. Addition of reinforcing materials decreases the sharpness of the transition without changing the position of the curve.

THEORY OF FILLER REINFORCEMENT. E. Guth. J. Applied Phys. *16*, 20-5 (Jan. 1945). For small loadings, up to about 10 percent volume parts, the colloidal carbon black spheres may be considered as suspended in a continuous rubber matrix. This model is generalized for ellipsoidal, including plate and rod-like, filler particles and it is extended to the computation of various properties of the suspension in terms of the properties of the matrix and of the fillers. Viscosity, Young's modulus, stress-strain curve below crystallization, and dielectric constant of the suspension are derived as linear functions of the volume concentration for small, and as quadratic functions for higher, loadings. The stress-strain curves for varying amounts of fillers are similar. For small loadings the tensile strength first decreases because of the stress concentrations occurring around the carbon black spheres when the samples are stretched. The increase of the tensile strength observed for greater loadings is caused by the tendency of the carbon black spheres to form chains and, finally, a type of network. The stiffness increases with loading, up to the point where the suspension becomes a dilution of carbon black by rubber. There the tensile strength decreases too. Binding of rubber by carbon black is similar to solvation. The theoretical conclusions were checked experimentally, the dependence of Young's modulus on concentration, the similarity of stress-strain curves, and the decrease of the tensile strength for small loadings. The theory of the elastic properties is very similar to the theory of Einstein on the viscosity of colloidal solutions and to Maxwell's and Rayleigh's theory of dielectric properties.

SYSTEMS MANIFESTING SUPERPOSED ELASTIC AND VISCOUS BEHAVIOR. A. V. Tobolsky and R. D. Andrews. J. Phys. Chem. *13*, 3-27 (Jan. 1945). Actual substances exhibit a very complicated behavior under mechanical stresses which cannot be described by classical elasticity theory nor by the classical theory of the hydrodynamics of viscous fluids. A general molecular theory describing the behavior of matter under stress is discussed and related to previous investigations and to experimental observations. Particular attention is devoted to rubberlike substances for which the classical theories are definitely inadequate. Experimental results on relaxation and creep of rubbers are interpreted in terms of modern structural concepts. These substances exhibit three regions of stress-temperature-time dependence. At intermediate temperatures there exists a region of relative stability in which the statistical-thermodynamic theory of rubber elasticity is valid. At elevated temperatures relaxation and creep are caused by chemical changes involving the rupture and formation of primary valence bonds. These chemical changes, which are responsible for the aging of rubber, can be isolated and studied by appropriate experimental techniques. At low temperatures relaxation and creep are caused by the slipping of secondary interchain bonds which are breaking and reforming in times comparable to experimental times of measurement. Theories are advanced to explain the observed stress-temperature-time behavior of rubbers over the entire temperature range studied.

SOFTENERS FOR GR-S—II. L. E. Ludwig, D. V. Sarbach, B. S. Garvey, Jr. and A. E. Juve. India Rubber World *111*, 180-6 (Nov. 1944). The effect of 600 softeners on the tensile strength, elongation, modulus, hardness, rebound, tear resistance, plasticity, flex life, tack, processing, rate of cure and reversion of cure was studied. Representative results are reported. A complete list of the plasticizers is given.

PLASTICS DIGEST

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General

SYNTHETIC FIBERS SET THE FORMULA FOR A TEXTILE REVOLUTION. Chem. & Met. Eng. *52*, 119-26 (Jan. 1945). This is a review of developments in synthetic fibers. The synthetic fibers considered are rayon, nylon, glass, casein, plant protein, vinyl resins, polystyrene, polyethylene, ethyl cellulose, cellulose acetate butyrate and synthetic rubbers. Synthesis, production, properties and uses are discussed.

COAL AND THE CHEMICAL INDUSTRY. J. G. Bennett. Inst. Fuel Wartime Bull. (Aug.) *1944*, 185-92. This is a review of coal as a source of raw materials for the synthetic fiber, resin and fertilizer industries. Fifty-one references.

PLASTICS AS ALTERNATIVES TO RUBBER FOR PROOFING PURPOSES. A. Ryan. Trans. Inst. Rubber Ind. *20*, 77-80 (1944). The merits and deficiencies of phenolic, cellulose nitrate, cellulose acetate, ethylcellulose, bitumen, polyvinyl chloride, polyvinyl acetate, polyvinyl chloride acetate, polyvinyl formal, polyvinyl acetal, carein and alkylpolysulfide plastics as proofing materials are discussed. The most suitable alternates for natural rubber are based on polyvinyl chloride acetate and polyvinyl acetal. However, the best plastic coatings are inferior to rubber in degree of flexibility, elasticity and adhesion.

SILICONES. R. W. Kolderman. Canadian Chem. & Process Ind. *29*, 147-52 (Mar. 1945). The properties of the silicone polymers are discussed. The resins described are made by the Grignard reaction from silicon tetrachloride, magnesium and organic chloride. The primary raw materials are sand, salt, coal and oil. The resins described include liquids, greases, elastomers and hard solids. Some of the materials are thermosetting. Various applications are described. Sixteen references are given.

PHYSICAL AND CHEMICAL INTERACTION BETWEEN PHENOLIC RESINS AND DRYING OILS. T. N. Mehta. Paint, Oil Chem. Rev. *107*, No. 9, 9-12, 46 (1944); No. 15, 20-2, 24-5; No. 16, 12, 14; No. 17, 14, 16 (1944); *108*, No. 1, 18, 22, 24 (1945). This is a review. Sixty-one references are listed.

THE ORGANOSILICON POLYMERS. E. G. Rochow. Chem. Eng. News *23*, 612-16 (Apr. 10, 1945). The organosilicon halides from which the silicones (organosilicon polymers) are made may be prepared by four different methods. In the Grignard method, an alkyl magnesium halide is reacted with silicon tetrachloride to form a series of organosilicon halides. In another method, the organosilicon halide is prepared by condensing an alkyl halide with silicon tetrachloride by reacting with sodium. In the third method, a reactive metal alkyl such as zinc diethyl is condensed with silicon tetrachloride. In the fourth method, unsaturated hydrocarbons such as ethylene and acetylene are reacted with silicon tetrachloride under pressure in presence of metal chloride as catalysts. The organosilicon chlorides react with moisture to form the silicones. If a mixture of a monalkyl silicon chloride and a dialkyl silicon chloride are hydrolyzed, cross-linked polymers are formed. Depending on the type and number of alkyl groups and the degree of polymerization, polymers with various properties may be formed. The methyl-silicone polymers are at present the most useful. The silicones range all the way from oils through elastomers to hard brittle solids.

Materials

INCREASING THE COMPRESSIVE STRENGTH OF FIBERGLAS-REINFORCED PLASTICS. G. Slayter. Ohio State Univ. Eng. Expt. Sta. News *16*, No. 4, 3-8 (1944). The adhesion of resin to glass fibers is improved by removing the water film previous to bonding. The water film is removed by heat-treating at 400° F. for 2 hours.

INSULATING OIL AS A BY-PRODUCT IN THE MANUFACTURE OF SULFATE PULP. J. Lagerqvist and G. Sandstrom. Svensk Papperstidn. *47*, 59-62 (1944); Chem. Abstracts *38*, 6426 (Nov. 20, 1944). The synthesis of resins soluble in mineral oils and of semi-liquid oils from tall oil by distillation and heat-treatment of the residue is described. Insulating oils made from these products have dielectric properties superior to those made from rosin.

XANTHORRHEA RESIN. Council for Scientific and Industrial Research, Australia. Bull. Imp. Inst. *42*, 74-82 (1944). This is a review of the information available on Xanthorrhea resin, a natural Australian resin. Results of studies made to determine the composition and the chemical properties of the resin are reported. Sixteen references are given with the text.

DIOCTYL SEBACATE. Rubber Age *56*, 633 (Mar. 1945). The properties of dioctyl sebacate, a plasticizer for polyvinyl chloride, are reported. Stocks containing this plasticizer have a bend-brittle point below −70° C. as compared to −50° C. for dioctyl phthalate.

PLASTICS FROM LIGNIN. R. S. Aries. Chem. Ind. *56*, 226-30, 416-20 (Feb.-Mar. 1945). This is a review article on the lignin plastics, with 159 references. The acid-hydrolysis, aniline hydrolysis, wood saccharification and lignocellulose processes for making plastics from lignin are described and evaluated. Other topics considered are chemistry of lignin, impregnated papers, paper-base lignin resin laminates, pressed boards made without extracting the lignin, soda-pulp lignin, alkali lignin, agricultural products and furfural. The properties of several of the products are given.

PLASTIC-BONDED MAGNETS. Plastics (London) *9*, 127-30 (Mar. 1945). This is a summary of a German article by Dehler in Elektrotechnische Zeitschrift *65*, 93 (1944). Permanent magnets made of powdered aluminum-nickel steel bonded with a synthetic resin are described and compared with cast magnets. The molded magnets are lighter, are easily molded to proper dimensions and are efficient.

CELLULOSE AND CELLULOSE PLASTICS. Ind. Eng. Chem. *37*, 226-68 (Mar. 1945). The six papers in this group were presented in a symposium on cellulose and cellulose plastics at the 108th meeting of the American Chemical Society in New York, N. Y., September 11-15, 1944. The following papers are included: "Recent Progress in Cellulose Chemistry," by W. Badgley, V. J. Frilette and H. Mark. Ibid. 227-32. Recent progress is reported in the field of cellulose and its derivatives in 3 respects: 1) the size and shape of cellulose molecules in dilute solution, 2) the polymolecularity of cellulose acetates; and 3) the existence of more or less easily accessible areas in bulk cellulose, particularly in fibers. The first and last items are apparently closely related to important mechanical properties of films and fibers made from cellulose or cellulose derivatives, such as ultimate tensile strength and elongation to break. They seem to be particularly important for the so-called transversal properties, such as resistance to folding, bending and shearing, but they influence other important technical qualities such as moisture re-

gain, swelling, dyeing, softness and luster. The second point appears to be of interest for the behavior of spinning and casting solutions, particularly for the degree of orientation and crystallinity which can be expected if such solutions are subjected to certain coagulating and stretching operations. "Weather Resistance of Cellulose Ester Plastic Compositions," by L. W. A. Meyer and W. M. Gearhart. Ibid. 232-39. "Cellulosic Molding Compounds," by R. H. Ball, C. E. Leyes and A. A. Melnychuk. Ibid. 240-6. "Interchain Order and Orientation in Cellulose Esters," by W. O. Baker. Ibid. 246-54. "Impact Testing of Plastics," by D. R. Morey. Ibid. 255-263. "Paper-base Laminates," by T. A. Howells and H. F. Lewis. Ibid. 264-8. Abstracts of the last five papers may be found on pages 168 and 169 of the November 1944 issue of MODERN PLASTICS.

Molding and fabricating

PREHEATING LAMINATED PUNCHING STOCK. British Plastics *17*, 74-8 (Feb. 1945). A continuous preheating method for laminated punching stock is described. The stock slides between two strip heaters.

Applications

ORGANIC INSULATORS IN THE ELECTRICAL INDUSTRY. H. Stager, W. Bedert and B. Frischmuth. Schweiz. Arch. angew. Wiss. Tech. *9*, 261-75, 314-21 (1943); Chem. Abstracts *39*, 1322 (Mar. 20, 1945). There are definite relationships between the molecular structure of organic insulating materials and the dielectric properties. There is no relationship between molecular structure and water permeability. The results of numerous tests are reported.

METLBOND ADHESIVE FOR METALS. G. G. Havens and H. R. Jenks. Iron Age *155*, 62-4, 136 (Jan. 18, 1945). A group of adhesives made by combining two adhesives, one having a synthetic rubber base and the other a plastic base, is described. The rubber imparts flexibility and adhesion to metal; the plastic component imparts the required flow at low curing pressures. Adhesives have been developed for both metals and non-metals.

RESIN ADHESIVES AND PLYWOOD. T. D. Perry. British Plastics *16*, 349-56, 358; 465-70 (Aug. and Oct. 1944). The history, properties and applications of synthetic resin adhesives in the manufacture of flat and curved plywoods and in the assembly of plywood and wood parts are reviewed.

PLASTICS AND THEIR FUTURE IN THE TEXTILE INDUSTRY. H. Jones. J. Soc. Dyers Colourists *60*, 225-32 (1944). The uses of plastics in the textile industry are reviewed. Plastics are used chiefly as 1) bodying agents for films, fabrics and pigments, 2) finishes of a more permanent nature, and 3) films for coated fabrics. Thirty-four references are given.

TROPIC-PROOF WIRING FOR RADIO EQUIPMENT. W. J. Tucker. Plastics (London) *9*, 79-82 (Feb. 1945). Electrical wire insulation which will withstand tropical deteriorating conditions is discussed. Plastic and rubber compounds are extruded over the wire. Natural rubber and polyvinyl-chloride compounds are the materials preferred.

PLASTICS SURVEY SHOWS MANY TEXTILE USES. C. N. Rabold. Textile World *95*, 93-97 (Mar. 1945). The properties of plastic materials are reviewed from the viewpoint of their applications in textiles. The results are presented in tabular form.

WET-STRENGTH PAPERS FOR MODERN WAR MAPS. C. G. Weber. Chem. & Met. Eng. *52*, 109 (Mar. 1945). A high wet-strength paper on which combat maps are printed is described. This paper remains strong and opaque in contact with water, oil and mud, can be washed when dirty and can be written on while wet. The paper contains 2.5 to 3 percent melamine-formaldehyde resin which is added to the cellulose fibers in the head box prior to formation of the sheet of paper. The heat applied to dry the paper cures the resin.

VEGETABLE PROTEINS AND SYNTHETIC FIBRES. D. Traill. Chem. & Ind. *1945*, No. 8, 58-63 (Feb. 24, *1945*). Various synthetic fibers made from vegetable proteins are discussed. The manufacture and properties of the fibers are described.

SYNTHETIC FIBERS GROUP MEETING OF THE AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS. American Dyestuff Reporter *34*, 21-37 (Jan. 15, 1945). The four papers which were presented at the meeting in Atlantic City, N. J., October 14, 1944 are printed together with the discussion on each. They are as follows: "A Survey of the Synthetic Fibers," by W. D. Appel. The present status of synthetic fibers is reviewed. The topics include composition, structure, dimensions, configuration, physical properties, chemical properties and future prospects. Four references are given. "Synthetic Fibers in Military and Post-war Fabrics," by H. W. Rose. The applications of synthetic fibers in military fabrics are reviewed. "A Survey of the Dyeing of the Synthetic Fibers," by A. W. Etchells. The principles of dyeing of the various synthetic fiber are considered. The solution to problems encountered with each type is shown by specific example. "The Use of Synthetic Fibers in Knitted Fabrics," by C. W. Bendigo. The problems involved in knitting synthetic fiber are discussed in the paper.

Coatings

WIRE ENAMELS. H. Liander. The Svedberg (Mem. Vol.) *1944*, 320-43; Chem. Abstracts *39*, 1301 (Mar. 20, 1945). The history and properties of wire enamels are reviewed. The advantages and disadvantages of the various high polymers used for this purpose are discussed.

TERPENES IN THE PAINT AND VARNISH INDUSTRY. F. Armitage. Paint Tech. *9*, 145-6, 169-71 (1944). The history, the properties and applications of the terpenes are reviewed. Terpenes may be copolymerized with indene, coumarone, maleic anhydride and phenols to form resins useful in the protective coating industry.

ORGANIC FINISHES FOR MAGNESIUM. G. C. Close. Light Metal Age *2*, No. 7, 20-2 (1944). The properties of a satisfactory primer for magnesium are discussed. Basic pigments are the most satisfactory. Zinc chromate has the best over-all characteristics. Suitable vehicles are oxidizing oils, phenolic resins, varnishes, tung oil, alkyd resins and cellulose nitrate lacquers.

USE OF POLYVINYL-ACETAL COATINGS FOR GASOLINE-PROOFING CONCRETE. S. N. Ushakov, E. M. Lavrent'eva, L. I. Medvedeva and E. I. Gretsova. J. Applied Chem. (U. S. S. R.) *17*, 125-36 (1944); Chem. Abstracts *39*, 1265 (Mar. 20, 1945). The strength and permeability to hydrocarbons and moisture of films of polyvinyl acetate, polyvinyl acetal and polyvinyl butyral were measured. Plasticized and unplasticized films were tested free and on concrete. The acetal and butyral were superior to the acetate. The polyvinyl butyral films swelled the least on exposure to hydrocarbons. Plasticizers have little effect on the swelling. The addition of kaolin as a filler to the butyral films practically eliminates the swelling in gasoline. All the resin formulations adhered well to concrete.

LAC-UREA COMPLEXES. M. Sreenivasaya and P. Subraya Sarma. J. Sci. & Ind. Research (India) *2*, 227-30 (1944); Chem Abstracts *39*, 427 (Jan. 20, 1945). Urea-lac complexes suitable for use in varnishes are described. Methods of preparation are given. The addition of urea improves the dielectric strength of the lac by 20 percent.

RECENT WORK ON ANTICORROSION PAINT. R. W. Moncrieff. Paint Manuf. *14*, 339-42 (1944). A review of recent advances in coatings for retarding corrosion of metal surfaces.

U. S. Plastics Patents

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 10 cents each.

SCREEN. E. Schweizer (to Celanese Corp. of America). U.S. 2,370,263, Feb. 27. A projection screen comprising a transparent plastic sheet having on one side a coating containing aluminum hydroxide.

ABRASIVE. G. Widmer and W. Fisch (to Ciba Products Corp.). U.S. 2,370,278, Feb. 27. Abrasive grit is wetted with a solvent for an aminotriazine-aldehyde resin and bonded with such a resin.

VINYL RESIN. V. Yngve (to Carbide and Carbon Chemicals Corp.). U.S. 2,370,280, Feb. 27. A plastic comprising an intimate solid dispersion of an aluminum hydrate with a copolymer of vinyl chloride and vinyl acetate.

CELLULOSE ESTERS. H. A. Tanner (to Eastman Kodak Co.). U.S. 2,370,332, Feb. 27. A coating prepared by treating a cellulose mixed ester with an aqueous soap solution, treating with water containing soluble salts of calcium, magnesium, aluminum, zinc or copper, washing, drying and finally dissolving in a solvent and adding a plasticizer.

CONTAINER. D. Ray. U.S. 2,370,419, Feb. 27. A gas-proof container comprising a heat-sealing inner portion, a layer of a polyvinyl alcohol composition, and an outer layer of a synthetic linear polyamide.

CELLULOSE ETHERS. S. L. Bass, R. M. Upright and F. L. Dennett (to Dow Chemical Co.). U.S. 2,370,517, Feb. 27. An aqueous solution is prepared containing a cellulose ether and a heat-hardenable melamine-aldehyde resin modified by condensing with a polyhydric alcohol, the water is vaporized from the solution, and the dry composition is heated until it is insolubilized.

FABRIC. A. A. Lawrence and S. L. Bass (to Dow Chemical Co.). U.S. 2,370,550, Feb. 27. A multi-ply stiffened fabric is prepared by forming a pile of sheets of cloth fabric, each sheet being separated by a preformed film of a cellulose ether, wetting the assembly with a swelling agent for the cellulose ether which comprises a water-insoluble cellulose ether in a water-soluble solvent, treating the assembly with water to arrest the swelling and precipitate the cellulose ether, and finally subjecting the assembly to heat and pressure.

COATING. V. Meunier (to Pittsburgh Plate Glass Co.). U.S. 2,370,562, Feb. 27. A formed polymer of an organic oxygen compound containing two reactive groups is coated with a polymer of an organic oxygen compound containing two or more polymerizable unsaturated groups.

POLYMER. I. E. Muskat and F. Strain (to Pittsburgh Plate Glass Co.). U.S. 2,370,565, Feb. 27. A polyester of a polyglycol and an acid ester of an unsaturated alcohol and carbonic acid in which both hydroxy groups of the polyglycol are esterified with the acid ester.

POLYMER. I. E. Muskat and F. Strain (to Pittsburgh Plate Glass Co.). U.S. 2,370,566, Feb. 27. A polymer of a diester of carbonic acid and a lactic acid ester of an unsaturated alcohol.

POLYMER. I. E. Muskat and F. Strain (to Pittsburgh Plate Glass Co.). U.S. 2,370,572, Feb. 27. A derivative of carbonic acid wherein each acid group is esterified with a half ester of a glycol and a monocarboxylic acid containing a beta unsaturated linkage.

POLYMER. I. E. Muskat and F. Strain (to Pittsburgh Plate Glass Co.). U.S. 2,370,573, Feb. 27. The polymer of a neutral ester of an hydroxy ester of glycolic acid and an unsaturated monohydroxy alcohol, and an unsaturated monohydroxy alcohol.

POLYMER. I. E. Muskat and F. Strain (to Pittsburgh Plate Glass Co.). U.S. 2,370,574, Feb. 27. The polymer of a bis (carbalkenyloxymethyl) carbonate wherein the alkenyloxy radical has an olefinic bond adjacent to the second carbon atom from the oxygen atom.

POLYMER. M. A. Pollack, I. E. Muskat and F. Strain (to Pittsburgh Plate Glass Co.). U.S. 2,370,578, Feb. 27. The polymer of an ester containing two polymerizable unsaturated aliphatic monovalent radicals is prepared by mixing with the monomer of the ester, a fusible soluble polymer of the same ester and polymerizing to an infusible insoluble state.

MOLDING. A. E. Gibson, Jr. (to Dentists' Supply Co.). U.S. 2,370,623, March 6. A method for molding thermosetting resinous materials.

KERATIN PLASTIC. C. B. Joseph (to Pilkington Bros., Ltd.). U.S. 2,370,669, March 6. A plastic material is prepared by treating keratinaceous material with an aqueous solution of a mixture of the hydroxide, sulfides and hydrosulfides of calcium, barium or strontium and precipitating with an acid.

CONTAINER. G. A. Moore (to Shellmar Products Co.). U.S. 2,370,680, March 6. A container comprising sheets of waxed paper and rubber hydrochloride.

TERPENE RESINS. A. L. Rummelsberg (to Hercules Powder Co.). U.S. 2,370,688-9, March 6. A resinous copolymer consisting of the reaction product of a terpene hydrocarbon and an acyclic unsaturated monobasic fatty acid or the glyceryl esters thereof.

EXTRUSION. H. Dreyfus (to Celanese Corp. of America). U.S. 2,370,721, March 6. Fused thermoplastic materials are delivered by pumping to an extrusion point which is immersed in a non-solvent liquid maintained at a temperature above the fusion point of the material.

FOOTWEAR. B. Glagovsky (to Haverhall Shoe Novelty Co.). U.S. 2,370,789, March 6. A shoe of the platform type having a middle sole with a marginal bead of polished synthetic resin.

FORMING METHOD. P. P. Weichbrodt and F. L. Williamson (to Bell Aircraft Corp.). U.S. 2,370,827, March 6. A flat sheet of thermoplastic material is formed into a dish shape by forming under heat and pressure in a dished shape mold.

CONDENSATE. W. J. Burke and J. H. Werntz (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,370,839, March 6. A condensate is formed by heating a mixture of an organic polyol, a compound having at least six carbon atoms and a labile hydrogen atom, and a bifunctional heteromonocyclic urea derivative at a temperature of 50 to 250° C.

PREHEATING. G. Smith (to Reed-Prentice Corp.). U.S. 2,370,883, March 6. An apparatus for dielectrically preheating material before molding.

PLASTIC. L. P. Hubbuch and P. Robinson (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,370,962, March 6. A fast-drying film-forming composition is prepared by heating a polyhydric alcohol

partially acylated with a fatty oil acid and alpha-beta unsaturated dicarboxylic acid at 140 to 160° C.

BANDAGE. R. Stone. U.S. 2,371,001, March 6. A bandage which is non-adherent to the skin, but which adheres to itself when wrapped, composed of gauze cloth coated on both sides with a composition of an unsaturated solution of polyvinyl acetate and a solvent plasticizer.

ORGANO-SILICON POLYMERS. J. F. Hyde (to Corning Glass Works). U.S. 2,371,050, March 6. A dichloro-, alkyl-, aryl-silicon compound is heated at 170 to 180° C. in the presence of water and air until a heat-convertible composition is obtained.

CELLULOSE DERIVATIVE. J. E. Kirby (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,371,052, March 6. Cellulose is regenerated in shaped form from a solution containing a cellulose derivative and a condensate of an aromatic amine with a maleic acid-olefin hydrocarbon interpolymer and the shaped product is finally brought in contact with an aqueous solution of a diazonium salt.

DIES. S. Milano (to Maryland Plastics, Inc.). U.S. 2,371,061, March 6. A method for producing sectional molds for molding plastic objects such as buttons.

VINYL RESIN. P. O. Powers (to Armstrong Cork Co.). U.S. 2,371,065, March 6. A viscous product is prepared by reacting a rosin, a saturated acid ester of vinyl alcohol or a partial polyvinyl acetal at a temperature of 270 to 280° C.

ORGANO-SILICON POLYMER. E. G. Rochow (to General Electric Co.). U.S. 2,371,068, March 6. Condensation of alkyl, aralkyl, alkylaryl, aroxyaryl, and halogenated and nonhalogenated aryl or alkaryl silicols is carried out in the presence of a boric acid ester.

FIBERS. M. Spertus (to Spertus Processes, Inc.). U.S. 2,371,075, March 6. Synthetic fibers are produced by bringing a synthetic thermoplastic resin into contact with a heating member and then pulling it away from the heated surface.

ENAMEL. R. C. Wood and H. R. Young (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,371,094, March 6. An enamel containing pigments, solvent, thiourea, a vegetable oil modified alkyd resin and a drier solution.

POLYVINYL ACETAL. E. R. Derby (to Monsanto Chemical Co.). U.S. 2,371,131, March 13. Polyvinyl acetal resin plasticized with the benzyl ether of diethylene glycol monopropionate.

COPOLYMER. T. L. Gresham (to B. F. Goodrich Co.). U.S. 2,371,134, March 13. A copolymer of vinyl chloride and an alkyl-aryl ketone.

LIGNIN. C. Harmon (to Marathon Corp.). U.S. 2,371,136, March 13. A process for producing lignin sulfonate compounds which consists of treating calcium lignin sulfonates with alkali, heating, treating with carbon dioxide at a pH of 10.7 to 11.0, filtering and finally precipitating with an inorganic acid.

LIGNIN. J. A. Orsino and C. Harmon (to National Lead Co. and Marathon Corp.). U.S. 2,371,137, March 13. Lignin sulfonate compounds are used in lead storage battery plates.

MOLDING PRESS. W. Strauss (to F. J. Stokes Machine Co.). U.S. 2,371,195, March 13. An automatic press for molding plastic articles.

HINGE. H. D. Watson. U.S. 2,371,200, March 13. A molded plastic hinge for a toilet seat.

WELT. W. C. Wright (to Wright-Batchelder Corp.). U.S. 2,371,204, March 13. A sewing rib of a vinyl resin is adhesively secured to a shoe insole.

REINFORCED PLASTIC. W. L. Rast and D. M. Musser (to Glenn L. Martin). U.S. 2,371,313, March 13. A plastic article is prepared by suspending fibers in a liquid, uniformly distributing a resin among the fibers, removing the liquid, compressing sheets of the material, preparing a 3-ply assembly with the center sheet, which is less compressed than the two outer sheets, and finally molding under heat and pressure.

WRAPPING SHEET. C. M. Rhodes and H. W. Wendorf (to Rapin-wax Paper Co.). U.S. 2,371,314, March 13. A transparent, flexible wrapping sheet is heat sealed by applying a coating of ethyl cellulose to one side of the sheet, a coating of hard wax upon the ethyl cellulose, and heating to effect a seal.

PLASTIC. E. G. Norton (to Monsanto Chemical Co.). U.S. 2,371,349, March 13. A method for preparing decorative sheets of plastic materials which comprises forming sheets containing pearlescent particles, stacking the sheets, fusing the sheets into a solid block and finally slicing at right angles to the composite sheets.

EXPANDED PLASTIC. G. R. Cuthbertson (to United States Rubber Co.). U.S. 2,371,382, March 13. A minimum mass of rubber chloride is placed in a mold and heated at 300 to 350° F. until the gases from the rubber chloride expand the mass so as to fill the cavity. Finally, the mold is cooled before removal of the shaped object.

VINYL RESINS. E. C. Britton and W. J. LeFevre (to Dow Chemical Co.). U.S. 2,371,499, March 13. A vinyl aromatic compound is polymerized in the presence of dicyclopentadiene, but in the absence of other polymerizable material.

TEXTILE PRESERVATIVE. A. W. Hanson and W. C. Goggin (to Dow Chemical Co.). U.S. 2,371,618, March 20. Textile materials are protected from attack by parasites by dusting a preservative and vinylidene chloride onto the material and heating it under pressure so as to bond the resin and preservative to the fabric.

ABRASIVE. H. C. Martin and F. A. Upper (to Carborundum Co.). U.S. 2,371,700, March 20. An abrasive article comprising a phenol resinoid modified by colloidal vanadium, chromium, manganese, iron, cobalt or nickel, in which are embedded grains of abrasive.

EXTRUSION MOLD. A. E. Rineer. U.S. 2,371,709, March 20. A device for continuously molding plastic material under pressure by extrusion.

RESILIENT MATERIAL. G. Schneider and M. E. Martin (to Celanese Corp. of America). U.S. 2,371,710, March 20. A pressure sealable material comprising a compact sheet of cellulose fibers containing a hygroscopic material and a facing of a preformed organic derivative of cellulose foil.

CELLULOSE ESTERS. C. J. Malm and M. Salo (to Eastman Kodak Co.). U.S. 2,371,768, March 20. A heat-resistant composition comprising a cellulose ester having a butyryl content of at least 25 percent; a residue of magnesium, calcium, strontium or barium; and an alcohol amine.

OUTLET STRIP. W. H. Frank (to Bull Dog Electric Products Co.). U.S. 2,371,816, March 20. A method for continuous manufacture of a longitudinally split strip comprising a hollow metal casing and a soft plastic liner.

DIOLEFIN POLYMERS. W. A. Schulze and W. N. Axe (to Phillips Petroleum Co.). U.S. 2,371,849, March 20. Aliphatic conjugated diolefins are polymerized by contacting with a liquid addition compound of boron fluoride in the presence of a large volume of a paraffin hydrocarbon.

LACQUER. G. R. Barrett (to Monsanto Chemical Co.). U.S. 2,371,866, March 20. A cellulose ester solution containing a small amount of an acid of phosphorus which has been at least partially neutralized by an organic amine.

BOOKS AND BOOKLETS

Write directly to the publishers for these booklets. Unless otherwise specified, they will be mailed without charge to executives who request them on business stationery. Other books will be sent post-paid at the publishers' advertised prices.

Symposium on Plastics

Published by American Society for Testing Materials, Philadelphia, 1944

Price $1.75 (paper); $2.00 (cloth cover) **200 pages**

The symposium held by A.S.T.M. Committee D-20 on Plastics in 1938 marked a turning point in the technical growth of the plastics industry. Methods of testing up to this time had been largely empirical and variable. The 1938 publication reviewed this situation and pointed the way for the accumulation of a fund of technical data in terms familiar to designers and structural engineers. This pioneering booklet has long been out of print.

The 1944 symposium was sponsored jointly by the Philadelphia District Committee, Committee D-20 on Plastics, and Committee D-9 on Electrical Insulating Materials. The papers review the progress that has been made in evaluating many different properties of plastics. A wealth of data is presented in condensed form in diagrams, tables, and bibliographies.

The topics considered include: heat resistance of laminated plastics; effect of environmental conditions on the mechanical properties of plastics; diffusion of water through plastics; stiffness and brittleness properties of nonrigid plastics; behavior of plastics under repeated stress; creep testing of plastics; testing in connection with development of strong plastics for aircraft; and a summary of properties, uses and salient features of families of plastics.

G.M.K.

Precision Measurement in the Metal-Working Industry, Volume II

Prepared by the Department of Education, International Business Machine Corp.

Syracuse University Press, 900 University Building, Syracuse 2, N. Y., 1944

Price $4.75 **300 Pages**

(Vol. I and II together $7.50)

The second of two books on the subject, this volume treats the more advanced types of precision measuring instruments and machines. In this group are included surface plates and accessories, sine bars, index heads, comparators, microscopes, optical flats, profilometers, measuring machines and hardness testers. The latest methods of inspection involving the use of Magnaflux, Managlo and Zyglo processes are also discussed. Written in simple style, the book will aid students and operators in securing a working knowledge of fundamentals and operations essential for the mastery of standard measuring methods, instruments and machines used in the metal-working industry.

Synthetic Rubber from Alcohol, A Survey Based on the Russian Literature

by Anselm Talalay and Michel Magat

Interscience Publishers, Inc., 215 Fourth Ave., New York 3, N. Y., 1945

Price $5.00 **298 Pages**

Increasing attention has been paid in recent years to the activities of Russian scientists whose achievements in the discovery and development of materials so closely parallels our own. Of especial interest is this survey of these scientists' findings in the field of synthetic rubber, based upon patents, articles and lengthier works produced describing their work.

This book falls into four major sections: 1) The Lebedev Process, 2) Technology of the S. K. Process, 3) Polymerization and 4) Physiochemical Properties of the Polymer. An interspersal of tables and charts completes this highly scholarly and well-balanced work.

Plastics and Industrial Design

by John Gloag and Grace Lovat Fraser

Published by George Allen & Unwin, Ltd., Ruskin House, 40 Museum St., London, W. C. 1, 1945

Price 10s. 6d. **166 Pages**

This book consists of three monographs, each an informative unit. Combined, they form an excellent over-all picture of the relation of plastics to the work of the industrial designer.

Section One propounds certain truisms already familiar to the plastics industry, among them the "limitless control of material" which enables the designer to create not only designs but also the material, limited only by public taste and his own capacity to use what is given him.

The second section is concerned with a presentation of the chief plastics within each major group. Chemical formulae are omitted but the bases, types, characteristics, properties, uses and methods of fabrication are presented in a straight workmanlike resume.

The third section which consists of a series of half-tones showing practical applications of materials is integrated with Section Two by numerous cross references.

★ A PERMANENT GROWING REFERENCE file on plastics patents is provided by the new loose-leaf Patent Digest Service, "Resins—Rubber—Plastics," published by Interscience Publishers, Inc., 215 Fourth Ave., New York 3, N. Y. As stated in their announcement, the editorial policy of this company is to cover all the American patent literature and, selectively, the foreign literature, on the manufacture of resins, rubber and plastics. Industrial applications of these materials will also be given. Twelve issues in loose-leaf form, comprising about 1800 pages, are to appear during the year to be filed into a binder according to a simple filing number printed on the abstracts. The subscription price per year is $45.00, the charge for the binder being $3.50.

★ "THE STORY OF PLASTIC Molding" is graphically presented in 24 pages by Chicago Molding Co., Chicago 51, Ill., in a booklet just released. Without attempting to be all-inclusive, the booklet gives essential facts and pertinent data in an arrangement allowing quick perusal and easy reference. Among the subjects touched on are general uses for plastics, uses for specific materials, mold making, production costs as affected by mold capacity, designing for molding, finishing processes and testing. A large table shows comparative physical properties of leading thermosetting and thermoplastic molding materials.

★ BATCH MIXERS WITH BEATERS, whips and agitators for mixing chemicals, cosmetics, adhesives, paints, inks and other materials are described in an illustrated bulletin from Reynolds Electric Co., Chicago 12, Ill.

★ IN "A BUSINESSMAN'S GUIDE to the Molding of Plastics," Kurz-Kash, Inc., Dayton 1, Ohio, gives a clear picture of compression and transfer molding. The booklet anticipates the questions that arise in the minds of businessmen about to enter the plastics field and provides them with direct answers accompanied by graphs of the properties of various molding materials and photographs illustrating the work of the designer, the mold-maker and the molder.

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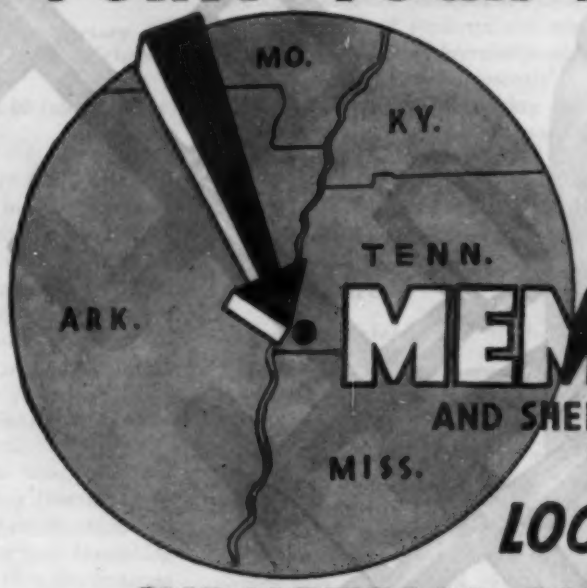

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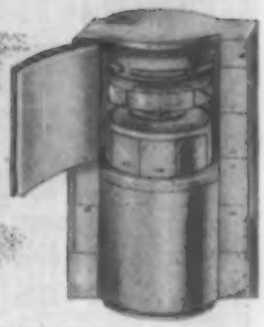

ER is our symbol of quality because, as the pioneer custom injection molder of America, no stone has been left unturned to develop to the highest degree, custom molded plastics.

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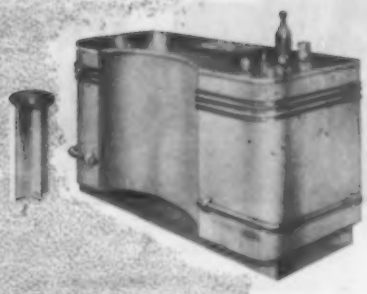

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IF you have stiff delivery schedules to meet . . . if you're having trouble with high rejections . . . if mold damage causes you frequent shut-downs . . . if you need to mold thick sections or larger-than-normal pieces—then it will pay you to investigate RCA electronic preheating. *RCA electronic generators for plastics molders are available for quick delivery!*

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The uniformity of preheating makes it possible to mold larger pieces; and the high temperature attained in preheating makes molding of thick sections (over ¾ inch) commercially practical.

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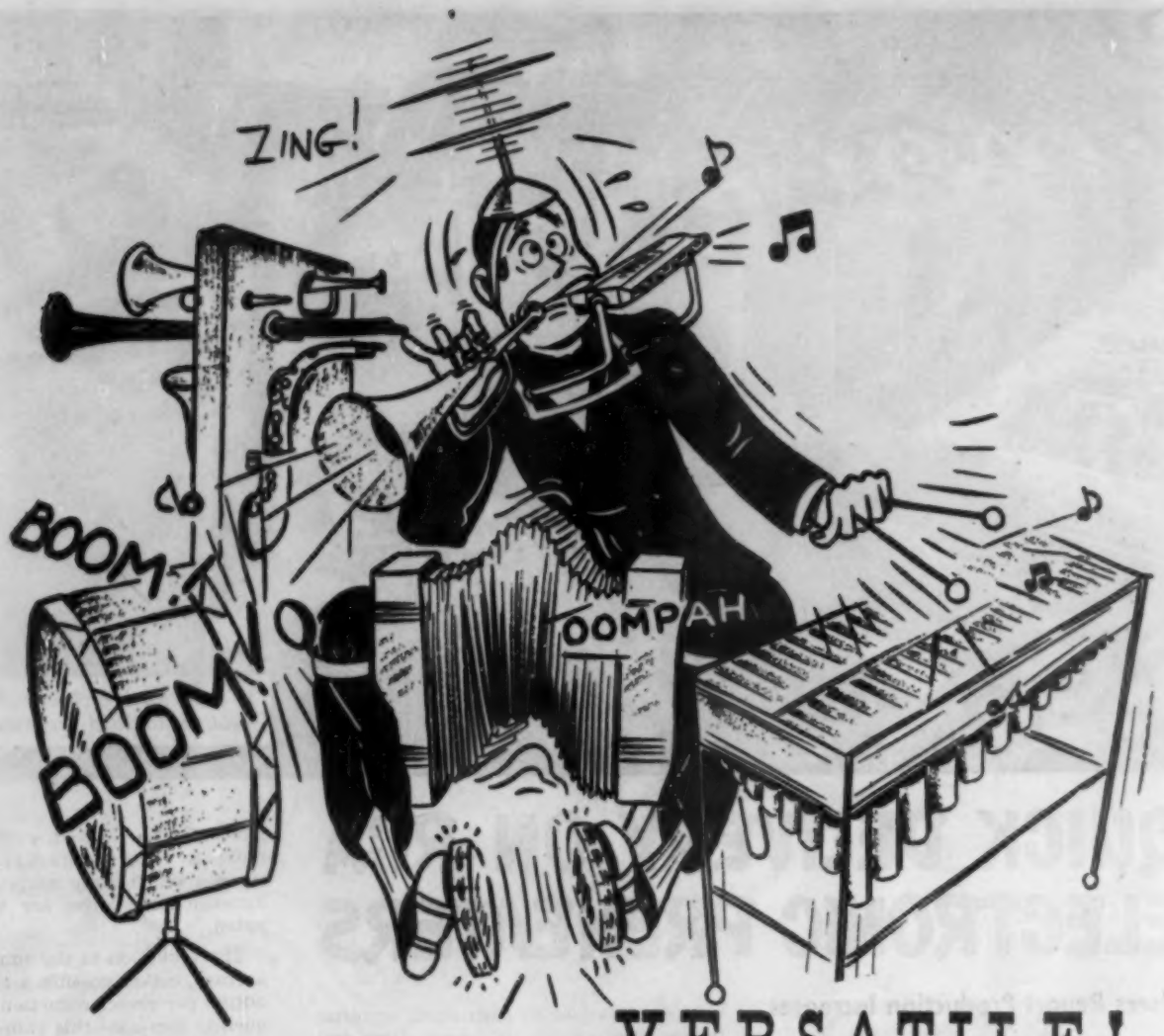

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Injection MOLDING

NUMBER SIX OF A SERIES

Most molders know that there are two distinct types of frame used in the construction of injection molding machines—the generally used bar-type and the Lester beam-type frame. Not everyone knows, however, the real difference in operating efficiency between the two types.

Mold locking power, a highly important factor in the density, structural stability and dimensional accuracy of moldings, depends largely on the rigidity and "stretch-resistance" of the frame itself, as well as on the mold locking mechanism within the frame. Strength of the frame depends directly upon the cross-sectional area of its members.

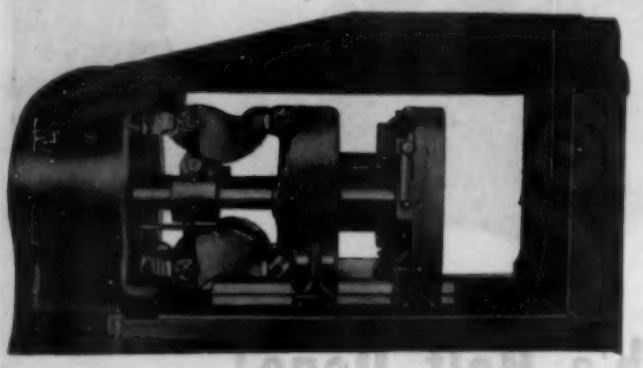

Fig. 1

Fig. 1 shows the massive construction of the beam frame used in building the 22-ounce Lester machine, which is made of solid molybdenum steel castings. Fig. 2 is a cross-sectional sketch of this same frame. It will be noted that the four members of the frame, each measuring 5" by 9", have a total cross-sectional area of 180 square inches. In order to attain equal cross-sectional area and comparable strength in a tie bar constructed frame, the bars would have to be more than $7^1/_2$" in diameter, a somewhat impractical size.

In actual practice (see Fig. 3), tie bars used in injection molding machines with rated capacities similar to that of the 22-ounce Lester are commonly 4" in diameter, each bar having a cross-sectional area of 12.56 square inches, or a total of 50.24 square inches for four bars.

Lester beam-type frames are pre-loaded to make sure that they cannot be stretched by the highest rated injection pressure of the machine. Within such frames, the patented Lester double-toggle and link mechanism, hydraulically actuated, locks the mold with a resisting pressure of 225 to 600 tons. The shock loading of injection is transmitted through hardened cam locks to the frame itself, relieving the toggle pins of any severe stress.

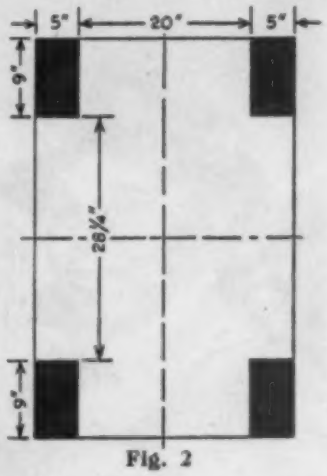

Fig. 2

An additional advantage of the beam-type framed is that, having no interfering bars, it provides ready access to the die space. In Fig. 2 note that the beam-type construction utilizes die space to the maximum, while in Fig. 3 the bars cut through the die space, reducing it. Other exclusive features of Lester engineering and construction combine to make better moldings at higher speed and lower cost. Why not drop us a line and get the whole story?

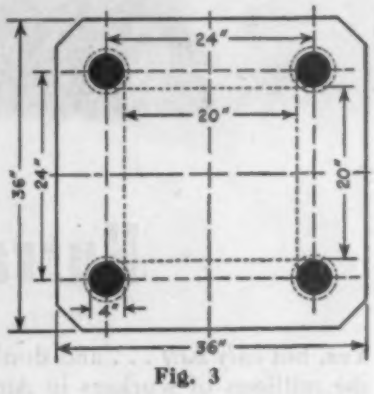

Fig. 3

Injection Mold Design

Islyn Thomas, New York plastics consultant, has written two clear and authoritative articles on the subject of injection mold design, planned to bring together the plastics customer, the sales engineer and the mold designer so that they may reach a better understanding of one another's problems. As a service to the industry we have reprinted these and offer them free to the readers of *MODERN PLASTICS*. Send for your copy today.

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NEW MACHINERY AND EQUIPMENT

★ A NEW ONE-PIECE FASTENER assembly has been developed by Simmons Fastener Division, Simmons Machine Tool Corp., Albany, N. Y., which is expected to simplify blind fastening. Called the Spring Lock Fastener, this assembly eliminates the need of lock washers, and will not work loose from vibration. To compensate for various material thicknesses within the range of the fastener, the assembly is self-adjusting and locks and unlocks with a quarter-turn in a

90-deg. clockwise rotation or can be permanently installed as a blind rivet. Construction of the head assures one-direction rotation for locking or unlocking.

The company announces, at the same time, design and construction improvements on its Quick Lock fasteners for cowlings and panels. The new design enables the part to fasten or unfasten with a quick quarter-turn. When unfastened, the stud is self-ejecting so that it can be noticed easily. The tapered principle of the fastener makes the unit valuable in assembling curved sheets.

A third item from the same company is a dual-purpose Safety Nut with unlimited application possibilities for all mechanical industries, according to the manufacturer. This assembly operates on the principle of the engagement of a snap ring in one of a number of longitudinal serrations in the bolt thread. With seven serrations on the bolt thread, there are 14 locking positions per revolution of nut. The serrations in the bolt thread are cut by a special internal broaching tool in a fraction of the time needed to drill cotter pin holes. If the assembly is used as a stop nut, these serrations are not necessary. When the nut is tightened and the locking ring snapped in locked position, the spring pressure provides a stopping action.

★ RANSOME MACHINERY CO., Dunellen, N. J., has announced the addition of Bench Model 1H, hand-operated positioner, to its line. This sturdy, compact machine is said to facilitate production and repair welding, assembly, overhauling, grinding, drilling, hard-surfacing and similar operations on all small work.

★ FOR USE IN HIGH TEMPERATURE re-circulating air systems, a new Chromalox air duct heater, Type TDH, has been developed by Edwin L. Wiegand Co., Pittsburgh 8, Pa. Air temperatures up to 1050° F. maximum may be obtained. The heater is easily and quickly installed in an opening in the air duct and is secured by bolting the mounting flange to the outside wall of the duct. The new air duct heater is rated at 230 volts, 6 to 30 kilowatts.

★ A TELESCOPIC TOWING HANDLE is the most recent optional feature which Lyon-Raymond Corp., Greene, N. Y., has added to its hydraulic elevating table. When not in use, the handle is collapsed and stays below the top of the table out of the way. When extended it allows the table to be moved more easily, especially on long hauls.

★ A NEW BRUSH-BACKED SANDing wheel, known as Sand-O-Flex, for sanding, deburring and finishing plastics, woods, metals, rubber products and many special materials has been developed by Exactone Tool & Die Co., Los Angeles, Calif. Eight strips of the abrasive, which is housed in the central magazine, extend

through the housing to be held against the work by tough bristles which "cushion" the abrasive, making it possible to get in and around corners, hollow and fluted surfaces and small openings. Twenty feet of abrasive are normally loaded at once by unscrewing the serrated nut and removing the cover. A wide range of abrasives of various grits and grades supplied for use with the sander and the ease of loading permit the same tool to be used in all operations from the rough stage to the polished surface. The sander has an over-all diameter (including brushes) of about 8 in. and, fully loaded, weighs about $2^3/_4$ lb. It is said to be especially adaptable to jobs formerly done only by hand.

★ A NEW PYROMETER WHICH IS portable and weighs only $1^3/_4$ lb. has been introduced by the instrument division of K. H. Huppert Co., Chicago, Ill. The instrument is specially adapted to reading

the temperature of hot air or liquids, molten metals (exclusive of ferrous metals) and hot surfaces, if used with the prod type of thermocouple. Its body design elevates the scale to an angle which offers maximum reading ease in all working positions and minimizes side reflections on the scale glass.

★ KINDT-COLLINS CO., CLEVEland, Ohio, has announced the development of a lubricant for band-saw teeth, prepared in the form of a stick 6 in. long and 1 in. in diameter. When pushed against the teeth of the saw blade in motion, the lubricant is said to prevent pitch from forming on the blade of a wood-cutting saw or to make cutting faster and easier. It is also designed to prevent chips from clogging the teeth if the saw is of the metal-cutting type.

★ AN INSULATING VARNISH SElector to facilitate selection of the right varnish for treating and insulating coils and windings and for general motor repair has been devised by the Resin and Insulation Materials Division of General Electric Co., Schenectady 5, N. Y. From the selector the user can obtain the catalog number of the varnish and complete data on characteristics of base, recommended thinner and baking or air-drying time. Seven varnishes are listed on the selector which can be obtained free from any local G-E merchandise distributor.

★ FOR ACCURATELY GRINDING round shank drills in four point angles—49, 59, 69 and 88°—an improved model of the super-drill grinding attachment has been developed by A. D. McBurney, Los Angeles 14, Calif. The new precision-made fixture will hold drills from $^3/_{32}$ to $1^1/_{16}$ in. in diameter and will sharpen short, medium and long twist drills $1^1/_2$ through 11 in. in length.

A fully hydraulic tablet machine

THE Watson-Stillman Co. has announced the development of a fully hydraulic tablet machine capable of producing 12 one-pound preform tablets per minute or approximately 10 two-pound tablets. The press is said to have a number of advantages, including great flexibility in pressure adjustment which makes possible the production of pills of varying sizes and shapes with any required density up to the machine's total tonnage.

The machine, which is of side plate construction, is built with Meehanite iron rams. The other castings are of steel. It is totally enclosed when in operation—the only exposed part being the die, slide and top plunger. Not only does this design lend the unit great neatness of appearance but it safeguards the working parts from the dust accumulations so prevalent in tableting rooms. The press is shown in Fig. 1 with the bottom ram and adjustment exposed. However, there is a removable panel with a single latch lock that covers this front part.

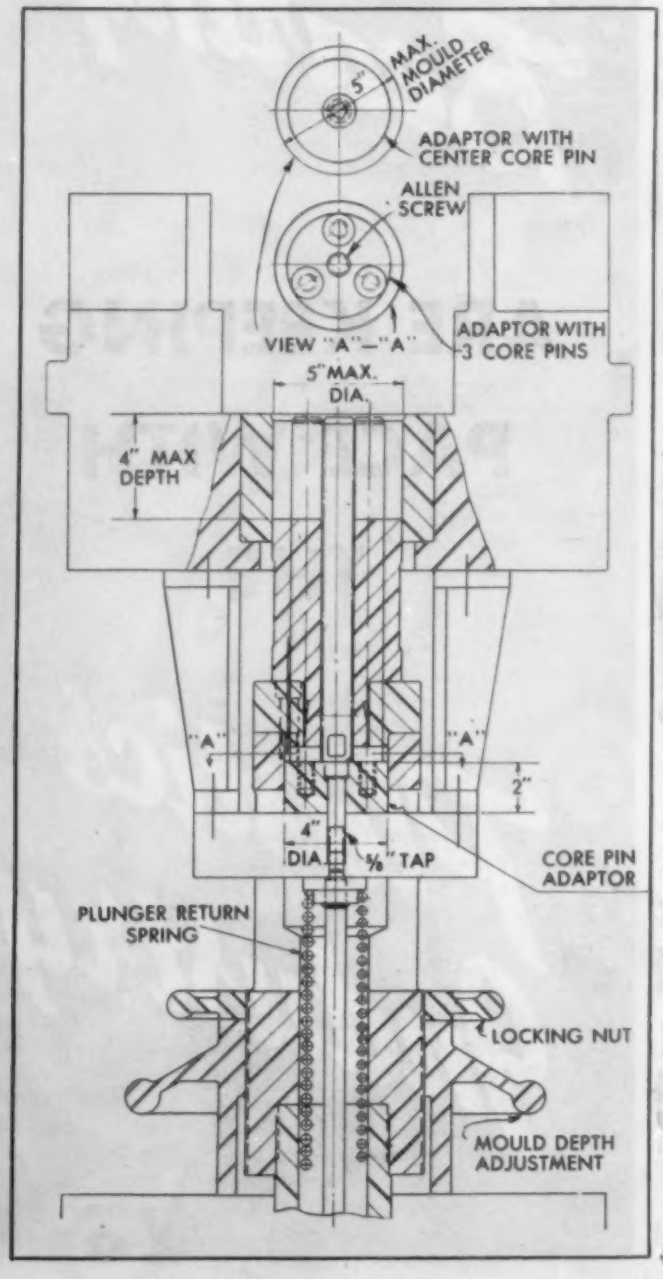
The largest die size which this unit will accommodate—5 in. in diameter with a maximum depth of fill of 4 in.—will produce a preform of general-purpose plastics material weighing 2 pounds. If adjustment is made in the filling slide, this machine will also handle semi-impact materials which can be preformed satisfactorily at the same rate as the general-purpose materials. The unit is designed to operate under 2000 lb. pressure with a pump delivering 23.4 gallons per minute. This gives the main cylinder an advance of 770 in. per min. and a high-pressure pressing speed of 52 in. per minute with the ram returning at a rate of 630 in. per minute. Arranged for fully automatic or semi-automatic operation, the press can also be operated manually, all the moving rams being capable of independent movement.

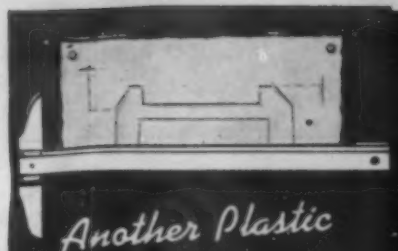
When the machine is operating fully automatically, the main ram is in its upward position at the start of the cycle. At the same time, the feed slide is directly under the material hopper ready for filling, and the bottom knock-out ram is in its upward position. As the slide advances to the die opening position, the bottom ram (*Please turn to page 196*)

1—*This fully hydraulic tablet machine is capable of producing 12 one-pound preform tablets per minute. It is shown here with bottom ram and adjustment exposed*

PHOTO AND DRAWING, COURTESY WATSON-STILLMAN CO.

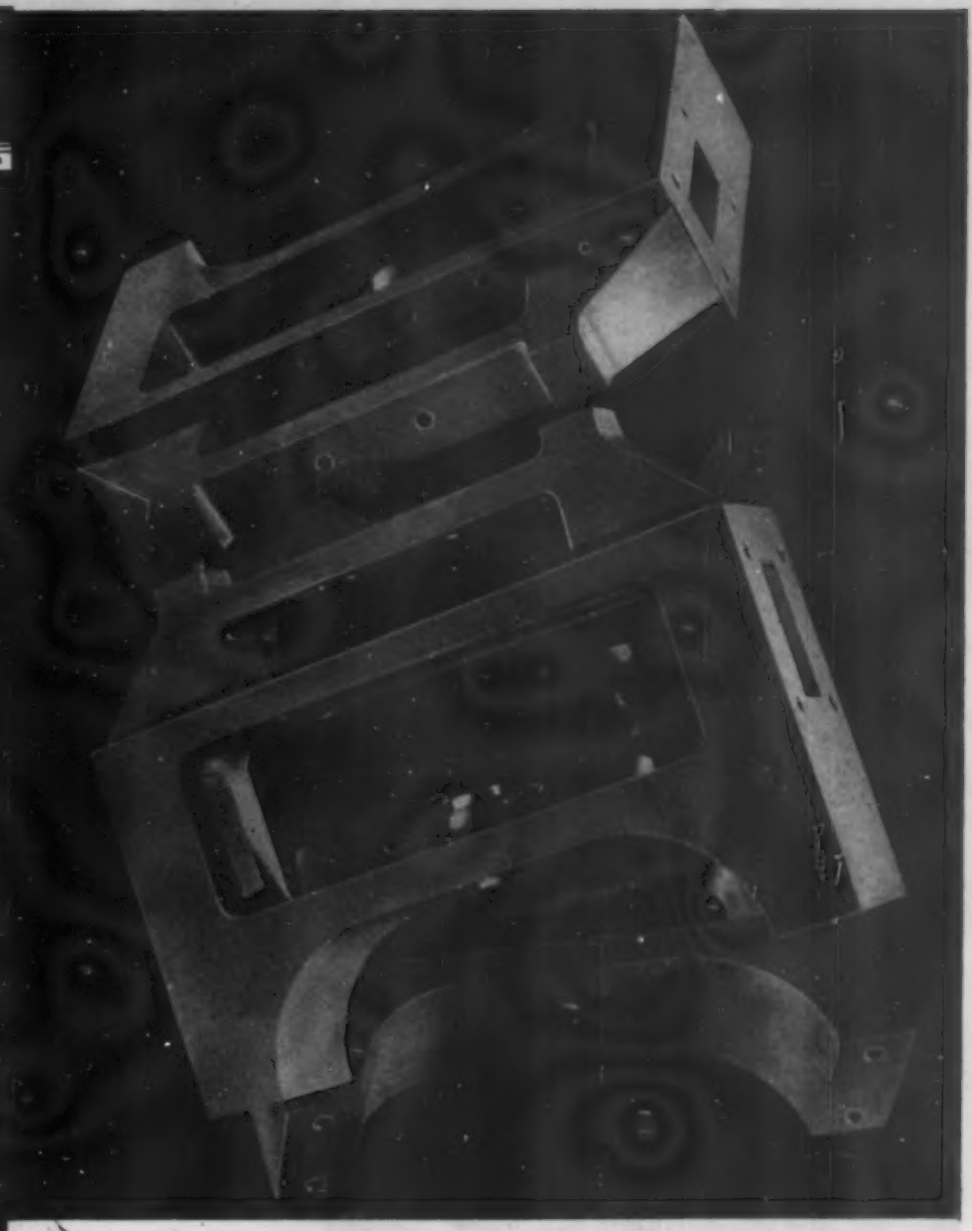
2—*Diagram indicates simple adjustment of mechanism necessary to insure adequate pressure on preforms. Also shown here is the core pin adaptor or multiple die adaptor*





Another Plastic Success Story

A leading manufacturer of electrical testing equipment brought this section of a capacitor switch to TECH-ART to mold. Sections of varying thickness complicated the molding problem — 20 inserts on 6 planes had to be spaced to minute tolerances — with high dimensional accuracy as an over-all requirement. And because the unit had to be used in measuring capacitance of high-frequency circuits, a material with high dielectric properties and resistance to heat was needed. TECH-ART engineers selected a suitable material, designed the necessary intricate molds requiring 4 side-pulls, and turned the job over to its master mold builders. The result was a precision-built mold that produced thousands of these accurate parts in the required time — Another difficult molding problem turned into another Plastic Success Story by TECH-ART.



AN *Exceptional* *Idea... Molded in* PLASTICS

Exceptional ideas like this one take shape every day in the hands of TECH-ART's engineers and master mold builders. Skilled mold-building craftsmen, following the designs laid down by TECH-ART's engineering staff, pattern contours of strength, appearance and serviceability with precision accuracy in every detail. And the wide variety of their creations is matched by TECH-ART's vast production facilities —including every type of compression and compression-transfer molding equipment, as well as a large battery of injection-molding units. It is this broad experience in *all* the details of plastic production which insures that your product, too, from its rough idea stage on, can be developed into another Plastic Success Story in the hands of TECH-ART engineers and mold-building craftsmen.

TECHNICAL NOTES

This capacitor switch-section was molded from a mineral-filled phenolic compound, selected for its high resistance to heat and dimensional change, good mechanical strength, and high dielectric properties required for trouble-free service in an electrical circuit.

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TECH-ART PLASTICS COMPANY

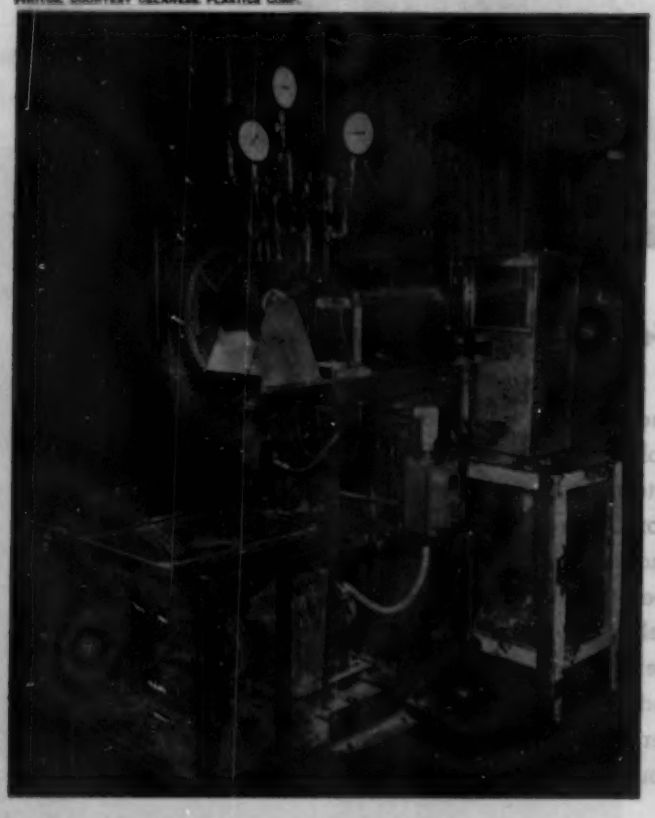
Automatic forming machine

FULLY automatic machines for the production of transparent plastic containers by the drawing method are in operation today in the Newark plant of the Celanese Plastics Corp., turning out up to 90 pieces a minute. Present production is concentrated on ammunition components made of nitrocellulose, but trials indicate that the machine will operate equally successfully on cellulose acetate, ethyl cellulose or any thermoplastic sheet. License for manufacture of the machine has been granted to F. L. Smithe Machine Co., Inc., which is authorized to sell the equipment without restriction as soon as construction materials become available.

Machines of the size now in use will draw containers up to $3^1/_2$ in. in diameter with a draw ratio of 1 to 1, but packages with diameters up to 12 in. are said to be entirely feasible, requiring merely a machine of larger dimensions. It is expected that the draw ratio also will be considerably increased in later models.

The cost potential in automatic manufacture of transparent plastic containers is most interesting. In addition to the fact that this new machine can produce at a rate more than four times as fast as the best semi-automatic methods, it has been found that one unskilled girl operator can supervise from four to six machines. Thus, production per operator has been boosted from a prewar level of 10 pieces per minute to as high as 400 or 500 pieces per minute.

PHOTOS, COURTESY CELANESE PLASTICS CORP.

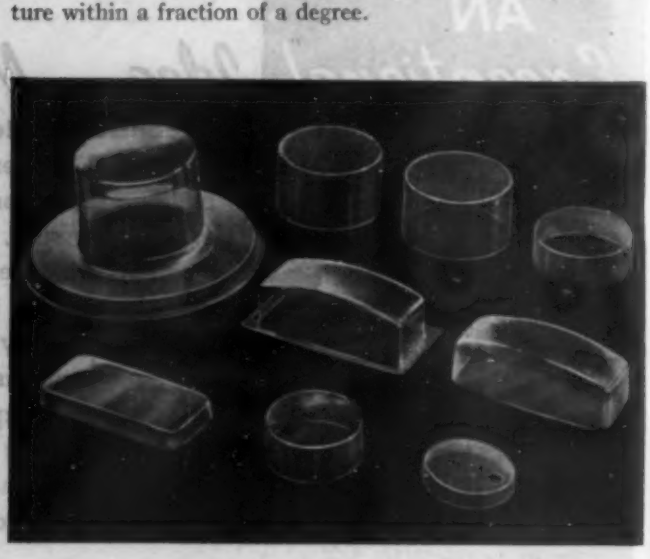


1—This fully automatic, high-speed forming press is capable of drawing plastic containers at a rate of speed more than four times as fast as that of the best semi-automatic methods in present use for this application

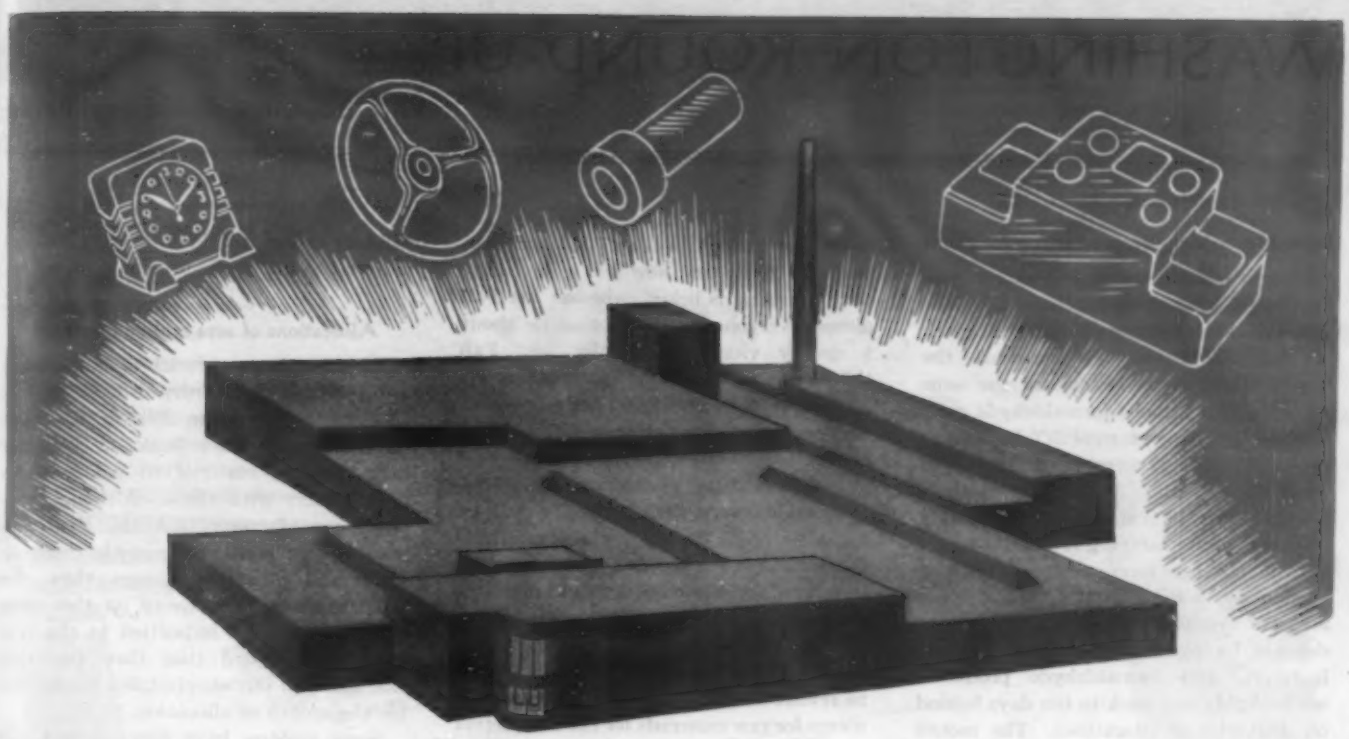
The new machine, designed by Rene Pipperoux, chief development engineer of the Celanese Corp. of America, and his assistant, Dmitri Soussloff, is covered by patent applications. Essentially its actions duplicate mechanically, by means of a cam-action press, the actions of hand-drawing. In fact, the real secret of the equipment is its duplication of the delicate double-hesitation movement of the manual stroke. Ten of the machines are now in operation in the Newark plant; each incorporating minor improvements over the preceding model, but all identical in appearance and principle.

The ammunition components currently being produced on these machines are of various sizes and shapes, but most of them are similar in size and appearance to telescoped pill boxes. The material is fed from a roll with the Hitch feed used on the semi-automatic machines. Not only is there a preheater plate, capable of providing any necessary preheating temperature, but the dies and hold-down plates are so designed that they too can be heated to any desired temperature. As the belt of material enters the dies, it is sprinkled lightly with zinc stearate powder which acts as a lubricant. The drawing stroke is made rapidly and, of course, automatically; and the piece is cut off automatically at the depth of the draw. As the dies open, passing the part through a cooling box, a blast of air from a port in the male die hits the part and loosens it, and a split second later another air blast hits the part from the side and blows it out into a hopper for collection. The operator has literally nothing to do except change the feed rolls, collect the finished pieces and watch for a possible jam-up should a piece fail to be ejected properly.

It is said that with proper change of heat, which is provided for, no difficulty has been experience in changing from nitrocellulose to cellulose acetate and ethyl cellulose materials. Since heat control must be very close, an electric pyrometer, mounted above the machine and connected with the heating elements, is employed to give a constant check on temperature within a fraction of a degree.



2—While these ammunition components of nitrocellulose are the chief output of this new machine, postwar possibilities for automatic production of transparent containers of any thermoplastic sheet are unlimited



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COMPRESSION AND INJECTION MOLDING OF ALL PLASTIC MATERIALS

WASHINGTON ROUND-UP

R. L. VAN BOSKIRK, Washington Editor

Record formaldehyde production for April

Largest shipments and greatest production in history were achieved by the formaldehyde producers during the month of April. Plastics also received the largest allocation in history for the same period. If any more formaldehyde were produced, there just wouldn't be enough available tank cars or tank trucks in which to move it. At the present time, all suitable tank cars that can possibly be corralled are carrying formaldehyde.

Although the increased production is good news, WPB indicates that supplies are still insufficient to take care of the demand by plastics raw material manufacturers, and formaldehyde producers are probably one week to ten days behind on deliveries of allocations. The month of June should see the formaldehyde situation in considerably better shape, provided that formaldehyde producers are up to date on deliveries, which in turn depends on continued tank-car movements.

More methanol for formaldehyde

Methanol—for a change—is in good supply and a stockpile has been nursed along. Tank cars have been moving methanol to formaldehyde producers in fine style, thus enabling them to run at capacity. As a matter of fact, the inside story on methanol is that there is no place to store current production, and some methanol production therefore will probably be converted over to ammonia. It is hoped that WPB will not allow another shortage of formaldehyde because of insufficient methanol production.

Aid in getting scarce materials

Many resin producers who operate under allocation orders have no preferred ratings to extend to suppliers of materials controlled by Order M-340. This inability to obtain a specific commodity can be avoided by appealing to the administrator of Order M-340, explaining to him specifically what material and how much material is needed to take care of an urgent use.

Study Paragraph (f) of Order M-300

V-E Day has arrived and Germany has surrendered. Last September, when the War Production Board announced that virtually all controls on production would be dropped immediately on X-Day, we advised in our bulletin No. 35, Sept. 8, 1944, that such statements should be taken with a grain of salt. Nobody knew then how it would be done or just what would happen. The chief difference between the outlook in May 1945 and September 1944 is that now it is a sure thing that Germany is licked, whereas last Fall almost everyone was too optimistic about a speedy victory. Secondly, last Fall there was considerable political interference which necessitated the talk about dropping all Government controls, while lately there has not been so much talk about immediate revocation of orders. Presumably very little publicity will be given to plans because of the sad mistakes made in the Fall in the trend toward reconversion. Most bureaus and divisions no doubt will work out their own problems and relinquish controls when materials become available. It will be impossible to revoke some orders because of requirements for raw materials for the completion of the war with Japan. Yet it is now certain that many chemicals will loosen up.

Fortunately, almost all of the chemical orders are flexible in that there are no limiting restrictions. In other words, no applicant is denied the right to use material by an order, although by allocation he can be denied permission to receive the material. On the whole, civilian uses for any commodity allocated by the Chemicals Bureau do not exist in any large degree. Chemical orders dole out all the material available and divide it among the most essential items. As more material becomes available due to military cutbacks, there will be more to distribute for civilian uses. As a result of this allocations system, it is possible that the reconversion of the chemicals and related industries may take place in a much more orderly fashion than the wild scramble which may start in other branches of industry.

Therefore we advise all applicants and producers who wish to obtain materials for civilian uses when military cutbacks occur to study Paragraph (f) of Order M-300. Actually, this paragraph means that such material as is available for indicated end uses will be released under Paragraph (f). When the applicant applies on Form WPB 2945, requesting material for civilian end use, and the supplier lists him on Form 2946 or 2947, the War Production Board will probably stamp "Paragraph (f)" both on applicant's and on supplier's forms, rather than allocate specifically to each applicant for a specific civilian use. This may leave many applicants in a quandary since nothing has actually been allocated to them. The truth of the matter is that under this method the applicant is in the supplier's hands. The supplier will be authorized to deliver X pounds either for specific end uses or for "any civilian uses." Military orders will doubtless be allocated material as under the present system.

Allocations of urea molding material

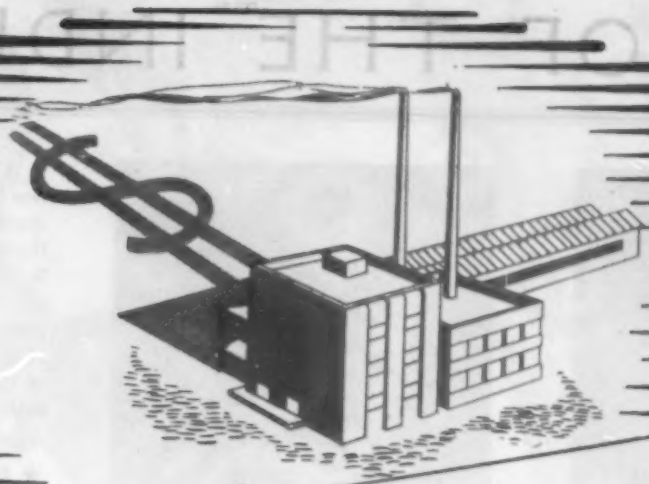
Urea molding material manufacturers are operating under Order M-300, Schedule 35, using WPB Form 2947 which gives them authorization to make deliveries of urea molding material to persons who place orders with them. Although material manufacturers list the customers who have placed orders with them on Form 2947, in many cases they also indicate proposed delivery on this same form, which is an indication to the War Production Board that they can ship this material out of scheduled production for the month of allocation.

Some molders have misconstrued this procedure because in certain cases the producer knows that he can make only so much of a certain type of molding material and therefore, attempting to help WPB in its allocation, indicates "so much material available for applicants requesting a certain type of powder." The supplier in no way takes the responsibility of setting up allocations for the War Production Board. WPB has issued and is operating under Order M-300, Schedule 35, and therefore assumes the full responsibility for allocations from the producers to the applicants.

How is formaldehyde allocated to plastics?

This is a question that many people would like to hear answered. All formaldehyde is allocated to producers to fill Allocation Order M-3000, Schedules 87, 34 and 35. This is determined by factors, information on which resin producers supply to WPB. Thus if a producer makes 1,000,000 lb. of resin and has a factor of 0.5 (1/2 lb.) of formaldehyde to make a pound of resin, he gets 500,000 pounds. Many times a producer makes different materials from month to month and therefore gets too much or too little formaldehyde. In general, the producer obtains as much as he has used in the past few months.

The original allocation of resin and formaldehyde usually eats up all the formaldehyde that can be shipped comfortably during the following month, which is why WPB continues to refrain from granting interim allocations. Producers continue to tell their applicants that they will have the formaldehyde to take care of the allocation, but they don't always get it. Then they put the heat on WPB to get more formaldehyde, which may not be available for shipment that month.



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JUNE, 1945

Dear Plastics User:

As the demands of industry increase in size, the facilities of suppliers are sometimes sorely taxed. This is especially true in the plastics industry where a number of small units have sprung up to serve the needs of local manufacturers.

It may cross your mind that your supplier should not only be financially stable – but financially able. He should have a sufficient financial background not only in size of investment, but in reputation for responsibility, which will enable him to handle your largest requirements without straining his resources.

He should be able to provide the necessary manpower, materials and machinery to meet your needs.

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Sincerely yours,

W. H. HOENIG
Treasurer

NEWS OF THE INDUSTRY

DR. GORDON M. KLINE

ROBERT L. VAN BOSKIRK

★ TWO MEMBERS OF THE EDITORIAL staff of MODERN PLASTICS magazine have been granted temporary leave of absence to visit the two major theatres of war on special assignments.

Dr. Gordon M. Kline, Chief of the Plastics Section, National Bureau of Standards, Washington, D. C., and Technical Editor of this magazine, has gone to Europe at the request of the War and Navy Departments on a special mission. The trip, which is the second of this nature for Dr. Kline—the first having been made at the invitation of the British Ministry of Supply and the Ministry of Aircraft Production in 1942—will be of several months' duration. He will travel in Army uniform with the privileges of a field grade officer, and his mailing address will be: Dr. G. M. Kline, Headquarters Comm. Z., ETOUSA, Office Chief Ordnance Officer, Tech. Div., APO 887, c/o Postmaster, New York, N. Y.

Under the auspices of the Navy Department, Robert L. Van Boskirk, Washington Editor of MODERN PLASTICS and MODERN PACKAGING magazines, is touring Navy bases in the Central Pacific area to observe the use and the performance of plastics applications and the packaging of war matériel under service conditions.

Both editors will report their experiences and observations on their return. This should prove to be interesting reading.

★ PRINCETON UNIVERSITY HAS announced a program of instruction and research in plastics which, according to Professor Kenneth H. Condit, Dean of the Princeton School of Engineering, has a twofold purpose. It is intended to meet "the growing demand in industry for men equipped with scientific or engineering training supplemented by a comprehensive background in plastics" and to conduct fundamental research in plastics.

Sponsored by the School of Engineering, the program is a cooperative enterprise of the departments of mechanical, chemical, and electrical engineering and of chemistry and physics. It is being developed with the assistance of an advisory committee of 16 industrialists headed by George K. Scribner, pres. of the Boonton Molding Co. Other members of the committee are: E. B. Babcock, vice-pres., Firestone Tire and Rubber Co.; R. V. Beshgetoor, mgr., Plastics Dept., Radio Corp. of America; R. M. Burns, chem. dir., Bell Telephone Co.; Allan W. Fritzsche, pres., General Industries Co.; Russell Hopkinson, dir., Chemical Div., United States Rubber Co.; William S. Landes, vice-pres., Celanese Plastics Corp.; Howard F. MacMillin, pres., Hydraulic Press Mfg. Co.; William H. Milton, Jr., mgr., Plastics Dept., General Electric Co.; R. J. Moore, tech. coord., Bakelite Corp.; Arnold E. Pitcher, gen. mgr., Plastics Dept., E. I. du Pont de Nemours & Co., Inc.; Frank H. Shaw, pres., Shaw, Insulator Co.; Norman A. Shepard, chem. dir., American Cyanamid Co.; Edwin A. Stillman, pres., Watson-Stillman Co.; William J. B. Stokes II, pres., Joseph Stokes Rubber Co.; Felix N. Williams, vice-pres., Plastics Div., Monsanto Chemical Co. Industrial concerns are also donating equipment for the plastics laboratory building and contributing financially to the enterprise.

Professor Louis F. Rahm, of the department of mechanical engineering, is chairman of the inter-departmental committee charged with the conduct of the program. Other members of this committee are Dean Condit and the chairmen of the other cooperating departments.

★ ANNOUNCEMENT OF THE ELECtion of Colonel H. A. Toulmin, Jr., as chairman of the board and president of Hydraulic Press Mfg. Co., New York, N. Y., and Mt. Gilead, Ohio, has been received. Howard F. MacMillin, former president, has been elected president of H-P-M Development Corp., a subsidiary of the company, where he will devote his attention to research work.

★ BY A VOTE OF ITS STOCKholders, Westinghouse Electric and Manufacturing Co. will be known henceforth as Westinghouse Electric Corp. The change of name, according to the announcement, was brought about for reasons of "simplicity and brevity."

★ RECOGNIZING THE IMPORtance of synthetic resins in the field of textile finishing, American Cyanamid Co., New York, N. Y., has formed a new textile resin department expressly organized to handle its products for this field. R. E. Sumner, who has been department sales manager of dyestuffs for Calco Chemical Division, will serve as manager of the new department.

★ ESTABLISHMENT OF B. F. GOODrich Chemical Co., a division of B. F. Goodrich Co., with offices and laboratories in Cleveland, Ohio, and manufacturing plants in Ohio, New York and Kentucky, has been announced by the company. The new division will be headed by Wm. S. Richardson, who has been with Goodrich since 1926. The Chemical Division will engage in the manufacture and sale of the company's line of Geon vinyl resins, chemicals, synthetic rubber and reclaimed rubbers.

★ EMPLOYEES OF SANTAY CORP., Chicago 24, Ill., were recently presented with the Army-Navy "E" for their high achievement in war production.

★ WE REGRET TO ANNOUNCE the death of Harold M. Bowman, general manager of Plastic Engineering Inc., Cleveland, Ohio, at his home on April 14. Mr. Bowman was a member of the S.P.I. and a charter member of the Cleveland Section of the S.P.E.

Sorry!

★ IN THE ARTICLE ON SIGNS AND Sign Making, which appeared on pages 116, 117, 196 and 198 of the May issue, the credits on page 198 should have read as follows: "Credits—Material: Lucite and Plexiglas. Signs by House of Plastics."

Acrylic model aids tunnel construction

THE aircraft industry, considered one of the most highly competitive in the field of modern business, recently set an example of cooperative effort for scientific advancement in its sponsorship of a wind tunnel for testing airplane design.

Spurred by wartime necessity, four Southern California aircraft companies—Consolidated Vultee, Douglas, Lockheed and North American—have cooperatively financed a wind tunnel for use by airframe manufacturers in carrying out aerodynamic development of current and new aircraft. The tunnel will be operated by the California Institute of Technology.

The purpose of all wind tunnel tests is to obtain data from which airplane designers can work. Because of the complexity of modern high performance planes, many varieties of data are required before a balanced design can be made. It is well-nigh impossible, or uneconomical, to obtain accurate data from planes in flight. For this reason, wind tunnels were developed.

The wind tunnel is a variable pressure, variable density, high-speed tunnel with a working section accommodating models of the size which experience has shown to be most satisfactory.

The working section is surrounded by a steel sphere, closed by a massive steel door and two gate valves which permit the section to be hermetically sealed. Three steel tables or carts carry models into the sphere on steel rails. Each has a different type of model support and can be rolled into or out of the sphere when the main door is opened.

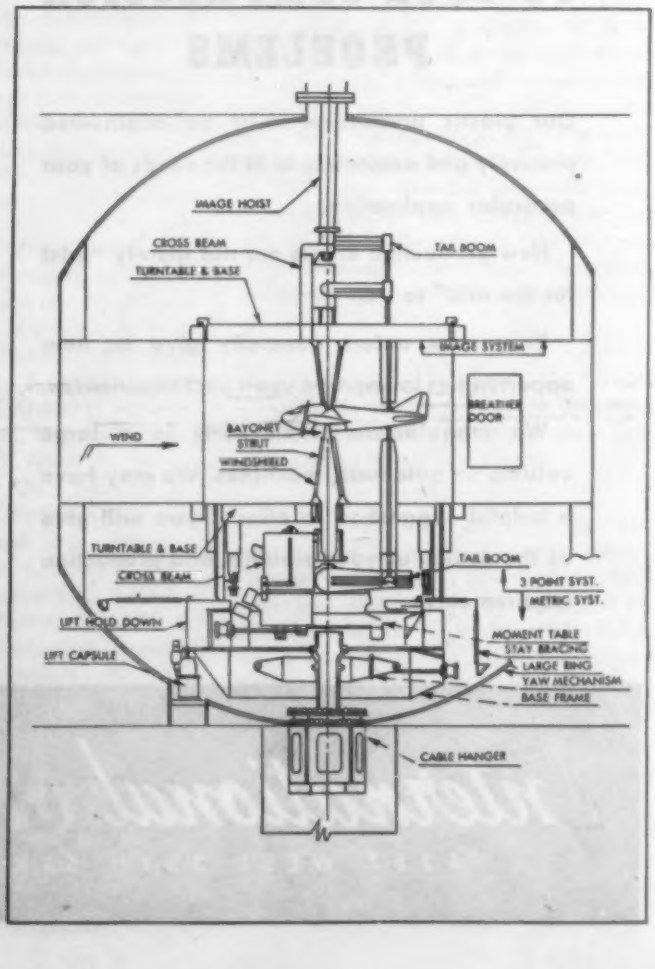
Obviously, so highly complicated a mechanism as this tunnel required much forethought and planning before it was actually constructed. The time, labor and investment involved allowed for no element of guesswork. For this reason, a clear plastic model of the sphere was constructed, matching in every detail the planned steel tunnel, even to a miniature plane set in position on the reproduction of the 50,000-lb. balancing system which enables engineers to measure with extreme accuracy the forces acting on the model.

The miniature replica was formed of clear acrylic, the major portion being made by hand. Only the more difficult rounded parts were turned in the shop. So faithfully did it copy the blueprints for the tunnel that engineers were enabled to make several changes—which the model showed to be desirable—in the plans for the steel structure.

Credits—Materials: Plexiglas. Model hand formed by Ann Machamer. Rounded parts turned at California Institute of Tech-no'ogy laboratories.

1—Design improvements were effected before construction of the tunnel with the aid of this acrylic model which faithfully reproduces every detail of the steel tunnel

2—A diagram of the wind tunnel showing the basic working elements of the structure in which are simulated actual conditions affecting a plane in flight



Flame resistant laminate

(*Continued from page 140*) is utilized in this operation to compensate for the advancement of the resin by the heat roll.

Standard practice in the manufacture of tube stock is to impregnate the filler by immersion, dry and coat the impregnated filler on one side with the resin solution and then redry the material. However, glass fabric is non-absorbent and it is not necessary to go through this double operation, as one coating by immersion impregnation is sufficient.

Today and tomorrow

At present, the entire production of glass fabric melamine laminates is used by the Armed Services in a wide variety of equipment for electrical insulation purposes. These range from the panel board itself to the slot wedges in the armatures of the generators. Radio manufacturers and industrial producers in general have already found uses for this material, and it is possible to justify these laminates in all cases where electrical insulation properties are the criteria of the workability of the apparatus.

The development of the glass cloth melamine laminate is of much significance to the laminating field. Physical and electrical properties have been raised and, as a result, present electrical equipment will have longer serviceability and wider application. The exceedingly high arc resistance and non-burning properties of these laminates make it possible for equipment to be designed and used which carries a higher load than was previously possible. The engineer will undoubtedly take advantage of these properties when contemplating future design.

Short-time tests

(*Continued from page 150*)

In certain parts of the sheet tested there was evidence of initial delamination near the center, indicating imperfect bonding. Because of this fact care was exercised in preparing specimens to avoid as much as possible regions in which imperfect bonding was evident.

Comparison of static tests

The results of tests of specimens cut parallel to the grain (Tables I, II, III) showed that the modulus of elasticity in compression was slightly higher than the modulus in tension, whereas the modulus of elasticity in shear as measured from the torsion tests was about one-eighth the tension modulus. The ultimate strength in compression was about 10 percent less than that in tension, but the yield strength at 0.2 percent offset in compression was only about one-half that in tension. The modulus of rupture in torsion was about one-seventh the ultimate strength in tension, and the initial (delaminating) fracture in torsion was about one-eighth the yield strength in tension at 0.2 percent offset.

Long-time tension creep tests

The equipment used for conducting the creep tests consisted of a steel rack from which 22 specimens could be suspended, calibrated weights and levers used for loading the specimens in tension, calibrated extensometers and a traveling microscope used for measuring the strain indicated by the extensometer, and a clock equipped with a counter to record the elapsed time in hours. Figure 12 shows the creep rack with loading levers, specimens, extensometers and auxiliary equipment. Figure 13 shows a specimen with strain measuring equipment in place. In this figure the specimen *A* was subjected to an axial tensile load through the rod *B*. The specimen was held by grips *C* which contained a hook-and-eye type of swivel joint. This joint was provided in order to minimize the possibility of eccentric loading. The extensometer used for measuring the creep consisted of a lever-type instrument with a traveling microscope *D* (Fig. 13) for measuring the displacement between reference marks on the end of the lever *E* and a stationary arm *F*. The lever ratio was 10 to 1. One end of the lever was forked and fastened by pivots to the lower clamp attached to the specimen. The axis of this pivot passed through the centroid of the cross section of the specimen (the pin itself did not go through the specimen). Thus the strain measured by this instrument was the average strain in the specimen, and it was not necessary to average the result of two or more instruments fastened to different sides of the specimen. The fulcrum of the lever was pivoted to a rod, the other end of which was fastened to the upper clamp on the specimen. A spring clip *G* (Fig. 13) was used to attach this rod to the upper clamp so that the extensometer could be left on the specimen during fracture without damage to the instrument.

Each instrument was calibrated against a micrometer screw before use. Flat clamps were used to attach the extensometer to the specimen instead of pointed screws, because creep of the material might cause screws to sink into the specimen, thus causing early fracture. The distance between the centers of the flat clamps was considered to be the gage length of the extensometer. As used in these tests, the gage length of the extensometer was 10 in., although in Fig. 13 the extensometer is set for 4 inches. A track was provided for the microscope so that it could be moved from specimen to specimen quickly.

Eight creep specimens (Fig. 1*e*) were tested simultaneously under a constant tension load at values of stress ranging from 0 to 9000 p.s.i. These tests were conducted in a room maintained at a constant temperature of 77° F. and a constant relative humidity of 50 percent for the entire time of the test which was 7000 hr., or about 10 months.

One specimen was tested at 0 stress in order to determine the magnitude of the shrinkage which might occur due to gradual change in moisture content or other aging phenomena. All tests were started at approximately the same time, and all were started by applying loads quickly but very gently to the specimen. Before applying the load, the initial extensometer readings were obtained with the traveling microscope. Then the loads were applied, the extensometer was immediately read again and the time was recorded. On the basis of the difference between these two sets of readings, the elastic strain was computed. Readings of strain and time were taken at intervals varying from two hours to seven days.

The results of these tests were plotted as shown in Fig. 14. It was observed that the tests started with a rather rapid rate of creep which decreased as time progressed. The lowest curve plotted in Fig. 14 is from the data for a specimen which carried no load, that is, 0 stress. This specimen was observed to shrink slightly during the first half of the test, possibly as a result of continuing reduction of moisture content of the specimen. The effect of short interruptions in humidity control is evident in all curves shown in Fig. 14. A decrease in relative humidity was observed to result in a rather marked decrease in length of all specimens, that is, approximately the same shrinkage, for all specimens, regardless of stress.

The specimen which was loaded to 9000 p.s.i. fractured after about 300 hours. The fracture occurred at the shoulder of the specimen and resulted primarily from delamination at that point. Thus, the actual stress which caused failure was not

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accurately known. The plotted point representing "elastic" strain is indicated by means of a short horizontal line at 0 time.

The effect of stress on the rate of creep.—The rate of creep did not remain constant throughout the time of testing, but decreased rapidly at first and then more gradually. In order to evaluate the effect of stress on the different rates of creep, it was therefore necessary to determine the rate of creep at a definite time. The rate was determined for a time of 5000 hr. by measuring the slope of the creep-time curve at 5000 hr. for each stress shown in Fig. 14. This rate of creep was then plotted against the stress on semi-logarithmic coordinates and is shown as the open circles in Fig. 15.

It has been found that the data shown in Fig. 14 can be represented by an equation (see reference 11) as follows:

$$\epsilon = mt^n \qquad \text{(Equation 1)}$$

where ϵ is the total strain and t is the time. The quantity m depends upon the stress whereas n is independent of the magnitude of the stress and depends upon material and possibly, temperature. Since the rate of creep is defined as $\partial\epsilon/\partial t$, it is possible to compute the rate of creep by taking the time derivative of Equation 1, from which:

$$v = \partial\epsilon/\partial t = mnt^{n-1} \qquad \text{(Equation 2)}$$

Thus the rate of creep v can be computed by substituting the values of m and n, determined in a manner described in another paper (11), and the value of the time, 5000 hr., into Equation 2. The values of rate of creep computed in this manner are plotted in Fig. 15 as filled circles. This method of determining the rate of creep for a particular time is more accurate than the slope method, and will give more consistent results.

It has also been found that the factor m can be expressed as a function of stress in the form (as shown in reference 11):

$$m = C_2e^{k\sigma} - C_2 = C_2(e^{k\sigma} - 1) \qquad \text{(Equation 3)}$$

in which σ is the tension stress, C_2 and k are constants. As shown in reference 12, the fact that Equation 3 accurately describes the relation between the factor m and stress σ is demonstrated by the fact that $(m + C_2)$, when plotted semi-logarithmically against stress, yields a straight line as shown by the square points plotted in Fig. 15. Thus the rate of creep can be expressed as a function of stress by substituting Equation 3 in Equation 2 with the result:

$$v = C_2(e^{k\sigma} - 1)nt^{n-1} \qquad \text{(Equation 4)}$$

The effect of stress on the amount of creep.—In order to evaluate the effect of stress on the magnitude of creep, the amount of total creep at a given time was plotted against the stress for each of the eight values of stress and is shown in Fig. 16. The elastic extension is shown as the lower curve in Fig. 16, and values of total creep at 100, 1000 and 6000 hr. are also shown. It was observed that most of the continuing deformation occurred within the first 100 hr., and also that the increase of deformation after the first 100 hr. to 6000 hr. was less than the initial, or elastic, deformation. The modulus of elasticity as determined from the reciprocal of the slope of the elastic curve shown in Fig. 16 was found to be 2,200,000 p.s.i. as compared to 2,240,000 p.s.i. determined from the short-time tension test.

Comparison of creep properties with other materials.—A comparison of the creep properties of this laminate with other thermosetting plastics for which test data were available showed that the total creep of all molded phenolic plastics reported (9) was 1.5 to 3 times that for the Mitscherlich paper at a stress of 2000 p.s.i., a time of 1000 hr., a temperature of 77° F., and a relative humidity of 50 percent. The materials studied in the references cited included phenolics filled with cord, rag, woodflour, asbestos, mica and pure resin. The Mitscherlich laminate also showed less total creep than all laminates for which creep data were available to the authors (10, 11). These laminates are phenolic laminates, Grades C, L and XX. The Grade C laminate had 2 to 3 times (depending on the stress) greater total creep at 1000 hr. than had the Mitscherlich. Grades L and XX had about 60 percent and 10 percent greater creep, respectively, at 8000 p.s.i. and 1000 hr. than had the Mitscherlich. The Grade XX laminate was tested at a relative humidity of 43 percent which would tend to decrease the amount of creep. However, the fact that the modulus of elasticity of the Grade XX was about 25 percent less than the modulus of the Mitscherlich would indicate that the increase in strain under the constant stress was about the same for the two materials.

Summary and conclusion

1. At a tensile rate of strain of 0.0016 per min. the modulus of elasticity in tension was 2,240,000 p.s.i. parallel to the grain of the paper and 1,080,000 p.s.i. across the grain.

2. The elastic modulus in compression was about the same as the corresponding values in tension.

3. The shearing modulus of elasticity as determined from a torsion test was 289,000 p.s.i.

4. The ultimate strengths were as follows: tension, 19,600 p.s.i. parallel to the grain and 11,800 p.s.i. across the grain; compression, 17,700 p.s.i. parallel to the grain and 14,400 p.s.i. across the grain; shearing (modulus of rupture in torsion), 2820 p.s.i. as determined from a specimen cut parallel to the grain of the paper.

5. The increase in strain due to creep was 0.26 percent after 6000 hr. at a tension stress of 8000 p.s.i. This increase in strain was equal to about 70 percent of the "elastic" strain at the same stress.

6. Creep data from eight specimens having different values of stress have been analyzed, with reference to another similar discussion, to show the effect of stress on the creep and the rate of creep. The rate of creep was found to decrease with time, but for any given time the rate of creep v was shown to be related to stress σ by an exponential equation:

$$v = C_2(e^{k\sigma} - 1)\,nt^{n-1}$$

where t is the time, C_2, k and n are constants.

Acknowledgment

The project reported in this paper was part of the work of the Engineering Experiment Station of the University of Illinois, Dean M. L. Enger, director, in the Department of Theoretical and Applied Mechanics of which F. B. Seely is head. The authors wish to express their gratitude to F. B. Seely for making it possible to carry on this work and for assistance in preparing the manuscript. The authors are also indebted to C. D. Kacalieff and W. M. Owen for assistance in conducting the short-time tests.

The authors take pleasure in acknowledging the generous cooperation of G. J. Muller of Taylor Fibre Co. who supplied the material and the information regarding its manufacture.

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Cutting wheel

(*Continued from page 152*) in Fig. 4. The cutting wheel is set above the table so that when the specimen is finished, the width of the reduced section will be the desired value. The height of the cutting wheel above the table is determined by the width of the specimen and the thickness of the bottom of the clamping device.

With the long dimension perpendicular to the plane of the wheel, the specimens in the clamping device are moved back and forth transverse to the plane of the cutting wheel and, at the same time, brought into contact with the bottom of the wheel. The movement of the specimen is so regulated that the side of the wheel cuts only that part of the specimen intended as the reduced section. The set-up preparatory to cutting is shown in Fig. 5; the cutting operation when partly finished is pictured in Fig. 6. The arrows indicate the directions of motion of the clamping device holding the specimens.

After the reduced section of the specimen has been cut out, the clamping device and the specimens are turned with the long dimension parallel to the plane of the wheel and moved against the wheel sidewise. The specimens are moved back and forth sidewise under the wheel and, depending on which end is being cut, they are also moved slowly forward or backward so that the material is cut away until the reduced section grades smoothly into the tapered sections. Figure 7 shows the specimens in position ready to begin this operation. Two views of the partially finished specimens in the process of being cut are shown in Figs. 8 and 9; the arrows indicate the directions of motion of the clamping device.

At the completion of this operation, the specimen is turned over in the clamp and the process repeated. The lines drawn on the edges of the blanks enable the operator to locate the reduced section and tapered sections symmetrically on the two sides. The result is a tensile specimen similar to that described in Method No. 1011 of Federal Specification L-P-406a. The fuzz which develops along the lower edge of the cut surface of the specimen during cutting is removed by trimming with a sharp razor blade and by rubbing lightly with fine emery paper. This finishing permits more accurate measurement of the dimensions of the specimen. The blank, a half-finished specimen and a completely finished specimen, are shown in Fig. 10.

The manufacturer of this equipment also makes wide cutting wheels which may be used to cut the tapered sections much as does a milling cutter. A $^3/_8$-in. thick wheel has been used in this manner and found to be satisfactory. The ordinary wheels are 0.025 to 0.064 in. in thickness.

Cost of equipment and specimen preparation

One ordinary wheel, which costs between $4.00 and $9.00, depending on the thickness, is serviceable for about 100 to 250 hr. of use. The thicker wheels are more expensive—the $^3/_8$-in. wheel costing about $40. The machine shown in Fig. 1 costs about $200.

The average number of specimens which are laid out and cut per hour from a glass fabric laminate of 0.2-in. thickness by one female operator is as follows:

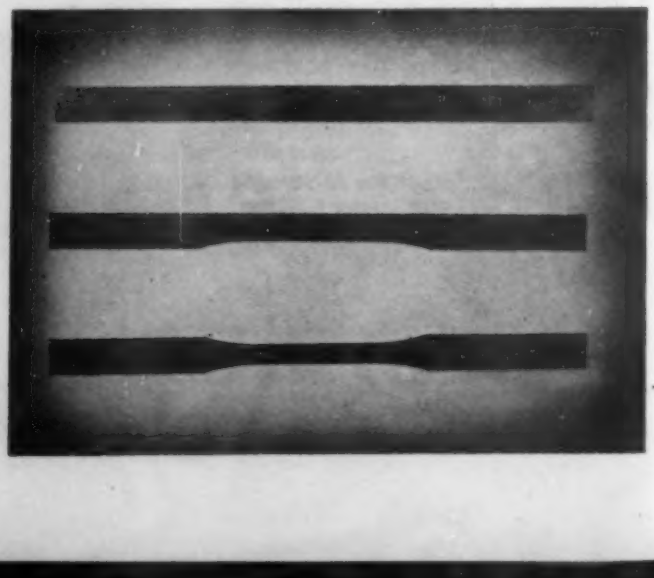
Test specimen	Average no. of specimens per hour from 0.2-in.-thick glass fabric laminate
Flexure	25
Tensile	12
Compression	20
Tensile-shear	20

Summary

Experience in the Organic Plastics Laboratory of the National Bureau of Standards in the use of the diamond-impregnated cutting wheel has shown that this equipment is satisfactory in all respects for preparing test specimens of thermosetting plastics, thermoplastics containing a high proportion of glass or mineral filler, and unplasticized rigid

9—A second view of the cutting operation necessary to produce the tapered portion of the tensile specimen

10—The blank, together with half-finished and completely finished tensile test specimen of glass laminate



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Specific Gravity	1.054
Tensile Strength, p.s.i.	6,900
Impact Strength, 25°C., ft. lbs./inch of bar	2.9
Compressive Strength, p.s.i. (Yield), 25°C.	16,000
Flexural Strength, p.s.i., 25°C.	12,000
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Clarity	Excellent
Color	Water White
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thermoplastics such as styrene and methyl methacrylate resins. The quality of the cuts is very good, and the method is rapid and inexpensive. Special procedures are described for making tensile and tensile-shear specimens with this type of equipment. This cutting wheel will not cut soft materials, nor will it cut the hand of the operator. It is made of a metal which permits pressure to be applied to the side of the wheel without danger of fracture. All these factors make its use practically non-hazardous.

Molded-in inserts

(Continued from page 127) of what a relatively small error in design can cost when the molded part gets into larger production.

	Production per day, sets of piece No. 1 and piece No. 2	*Man days necessary for this production*	*Press days necessary for this production*
Using side inserts	1600 sets	36	24
Using drilled and tapped holes	1800 sets	8	6

It is easy to see from these figures that if the inserts had been eliminated, there would have been a daily saving of 24 man days and 18 press days. Breaking the figures down a little further, it is found that there would have been a saving of 15 man days and approximately 10½ press days per thousand sets of firing blocks and fuze-setting rings.

In the last few weeks since this article was prepared, the Navy has permitted the production of the fuze-setting ring without the four inserts. Figures 2 through 8 indicate the molding of this part as it is now performed. Due to the fact that the molds are already produced, it would not, of course, be economical to change over from transfer to compression molding. However, this job has become a straight draw job with no side pins which is a far simpler molding operation than the method formerly employed.

Credits—Material: Bakelite. Molded by Mack Molding Co. for the Navy.

Tablet machine

(Continued from page 180) retracts and allows the cavity to fill. The feed plate then returns to its position underneath the hopper for the succeeding load.

On its return, the feed plate contacts a limit switch which starts the main ram on its downward stroke. When a predetermined pressure has been reached, a pressure switch halts this downward movement and starts the ram back to its upward position. Concurrently the ejector ram moves up, discharging the tablet of material. As the feed slide moves forward for the succeeding fill, it pushes this ejected preform clear of the die and into a material chute.

Due to the fact that this machine is fully hydraulic, accurate set-ups are not needed to insure adequate pressure on the preform. In fact, the depth of fill can be regulated while the machine is in operation. It is only necessary to unlock the locknut and adjust the depth of fill by turning a large hand wheel which is readily accessible from the front of the machine. This adjustment in mechanism is shown in Fig. 2 as is a core pin adaptor, or multiple die adaptor. The correct regulation of this device, which has a diameter of 4 in., makes it possible for the cores to be placed within the 5-in. die which, as stated previously, is the maximum size that can be taken by this press.

Pocket compass

(Continued from page 124) at random from every 100 compasses produced, are put through a series of tests.

One of the most critical requirements is that the compass be of the "dampening" type; that is, one on which the compass card, or dial, will not fluctuate as the direction changes. Instead, the card must swing gradually and steadily in the new direction. To achieve this action, the instrument is immersed in compass liquid which acts as the dampening factor.

The need for a pocket compass of this type first occurred to George Peterson, of the Emergency Reserve Branch at Wright Field, Dayton, Ohio, and a representative of a Chicago molding company while inspecting a fighter plane cockpit.

A combination compass and match container was not a new idea; in fact, Government specifications for such an article have been in effect for a number of years. However, previous compasses of this type had not proved entirely satisfactory. This new dial-type liquid pocket compass was finally designed and engineered through the joint efforts of the molder and officials of the Compass Unit, Instrument Section of the Equipment Laboratory, at Wright Field, under the supervision of Major Jack Callahan.

The compass is injection molded of cellulose acetate butyrate at a slow cycle to keep maximum dimensional control. Seven multiple-cavity dies are used in the molding process.

These compasses, produced at the rate of 2,000 daily, are inspected by operators stationed along the assembly line. Operations include shadowgraph inspection of the individually ground pin and pin-head on which a fine jewel bearing is mounted when the pin is assembled into the screw machine. Length and bearing must be absolutely correct. The area on top of the card is filled with radium. An expansion chamber permits expansion and contraction of compass liquid under extremes of temperature. The card holds two Alnico magnets of identical dimensions to guarantee perfect balance.

Credits—Material: Tenite II and Lumarith. Manufactured by DuPage Plastics Co. for Army Air Forces

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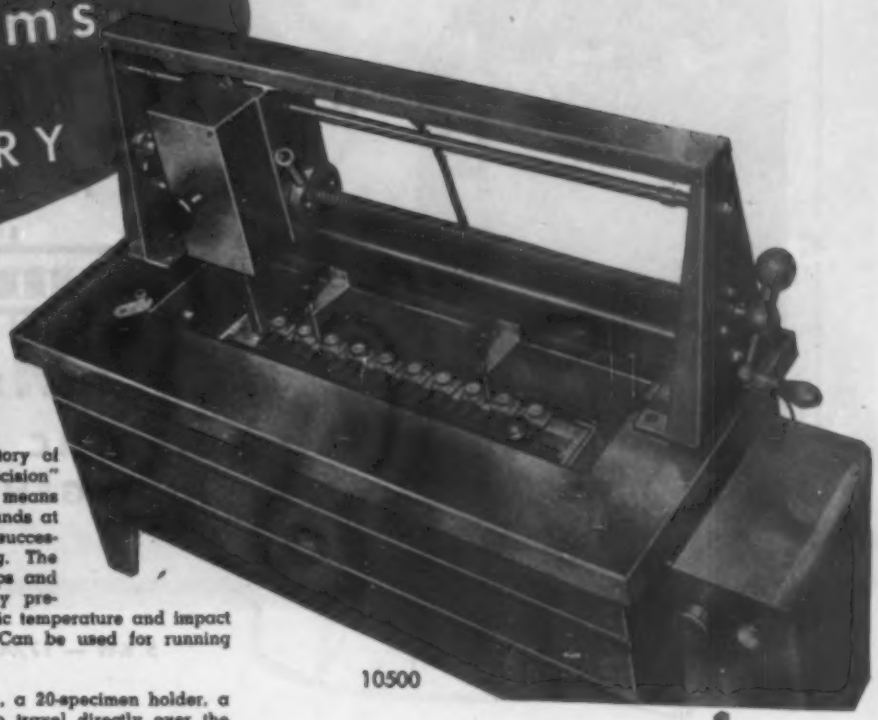

10500

Developed in cooperation with the Rubber Laboratory of the E. I. DuPont de Nemours & Co., Inc., the "Precision" liquid immersion type Brittleness Tester provides a means for determining the brittleness of elastomeric compounds at sub-zero temperatures. Twenty specimens can be successively tested in about one minute after conditioning. The specimens can be inserted under quick-acting clamps and securely held at any desired temperature for any predetermined time. Tests can be started at any specific temperature and impact tests made in decrements of every five degrees. Can be used for running ASTM D-746 tests.

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The tester is made of stainless steel and copper, with 3" of cork insulation throughout. Approximate overall dimensions are: 30" long, 13" wide, 14" high.

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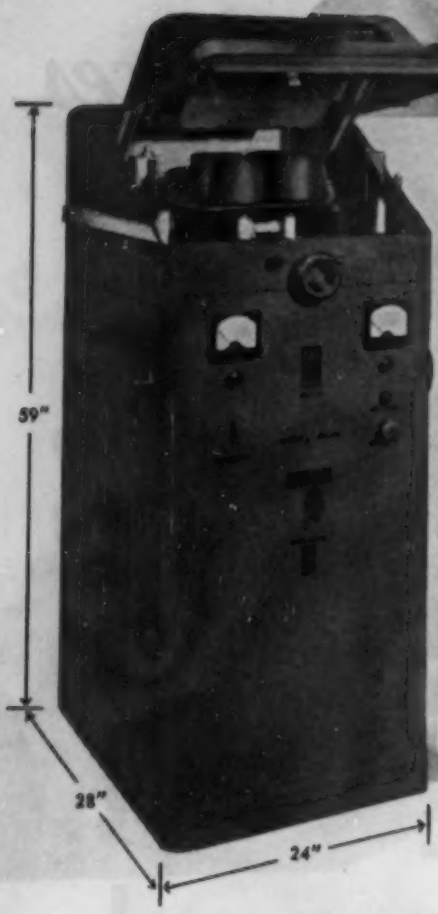

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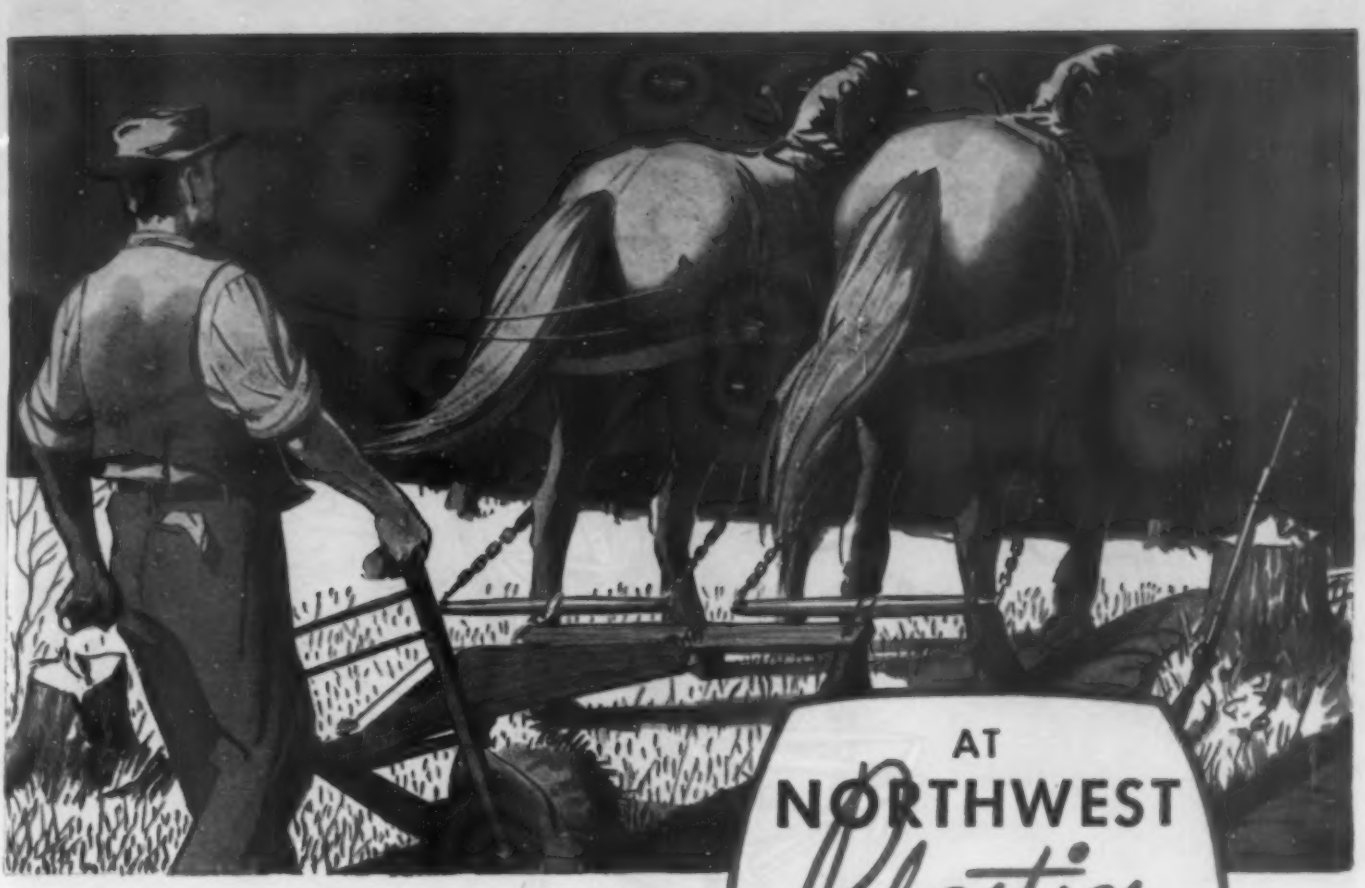

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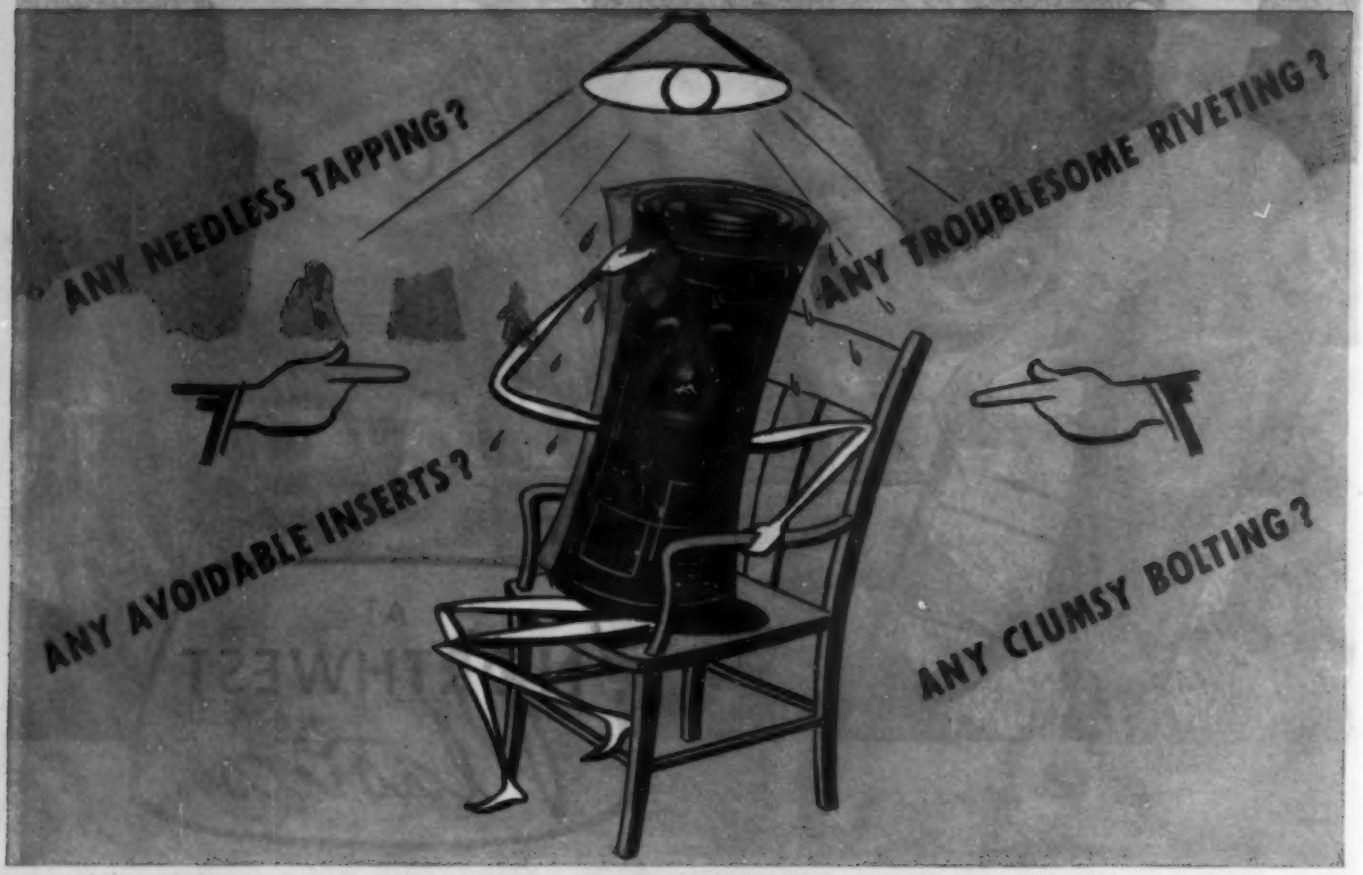

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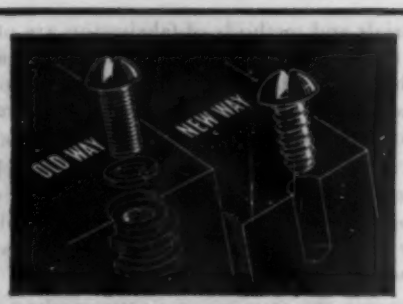

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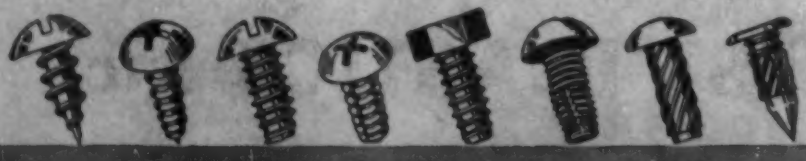

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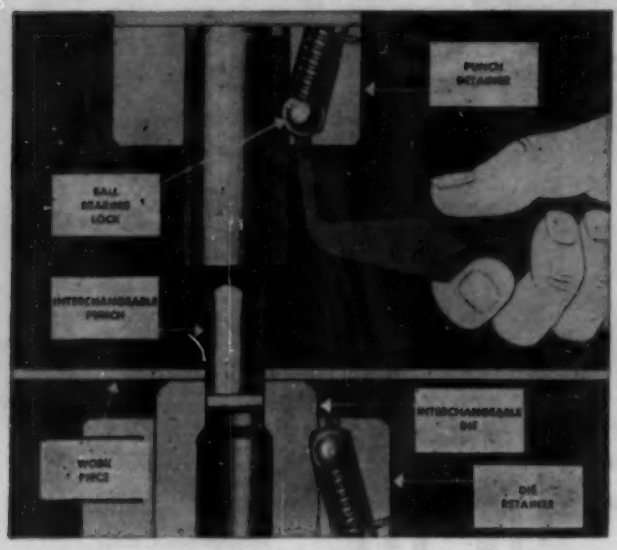

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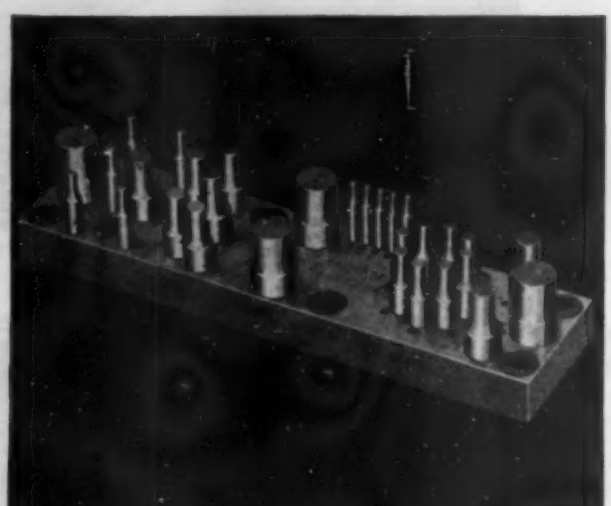

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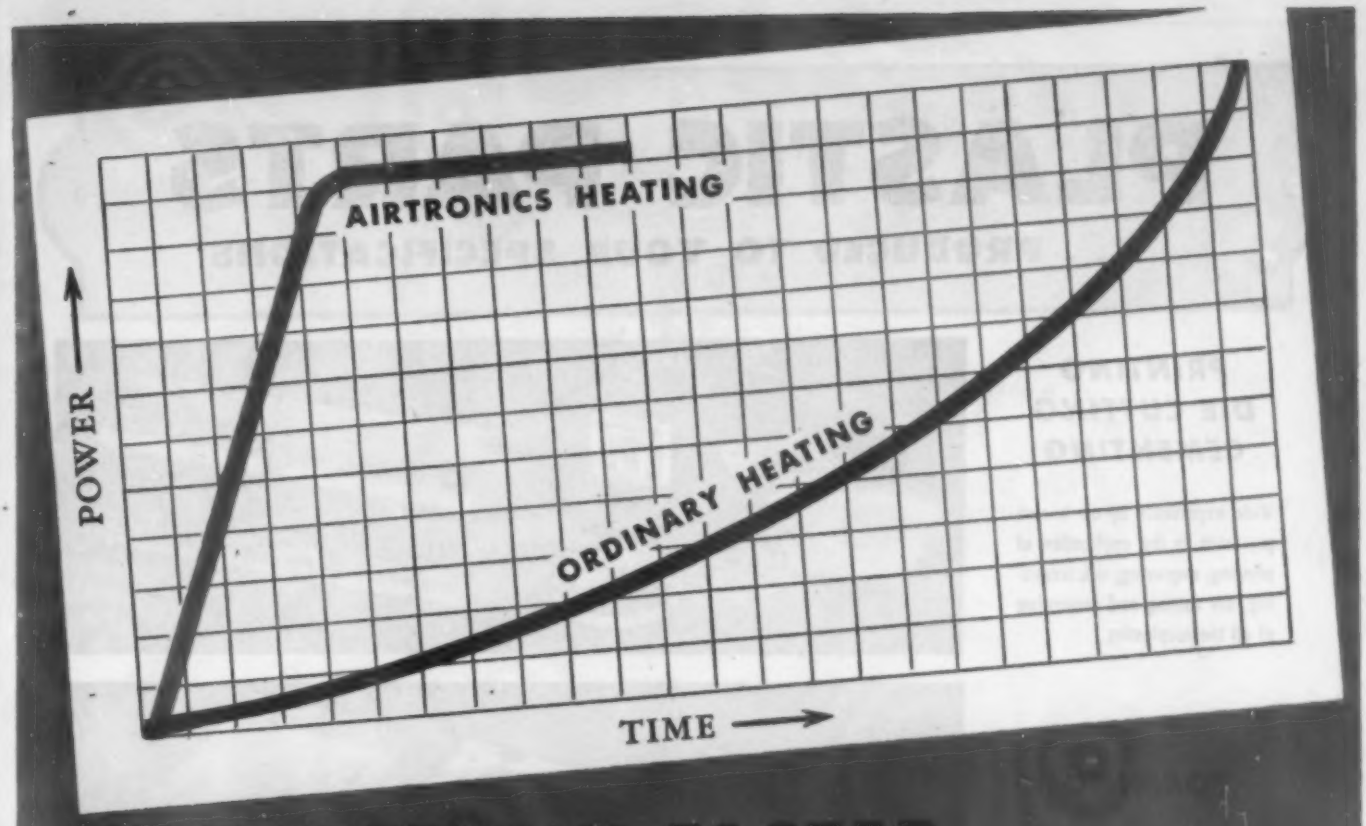


HOT PREFORMS FASTER . . .

with AIRTRONICS Full-Cycle Peak Heating

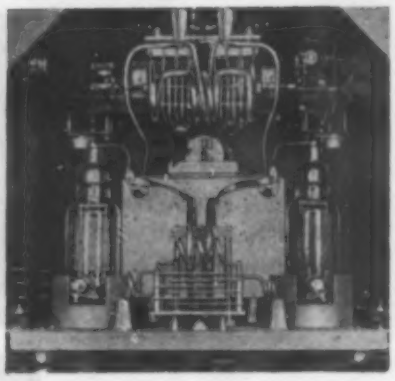
With ordinary electronic preheaters, the output power rises gradually during the heating interval and maximum power is reached only at the end of the cycle. In the AIRTRONICS Model DE, the output power rises rapidly to maximum *and stays there* throughout the heating cycle . . . resulting in faster heating of more material per kilowatt of power.

This peak preheating is accomplished through the combination of AIRTRONICS Automatic Power Regulation and AIRTRONICS Automatic Tuning which keeps power at its peak during the entire heating cycle regardless of variations in preform characteristics. *No other preheater utilizes this production-speeding combination.*

Additional advantages of the AIRTRONICS Model DE are:

- ***2.5 KW output power***
- ***Dual load selection — providing two independent sets of controls that can be preset to heat molding material for two presses running different jobs***
- ***Compactness and mobility***

These high-production advantages give you more usable BTU's per second . . . more BTU's per square foot of floor space. The Model DE makes preheating simpler and faster. In many cases it can actually *double* your preheating capacity Send for the new four-page folder that describes it in full detail. Write Dept. M.P



Automatic Load Circuit Tuning and Automatic Power Control are accomplished by specially designed electronically-controlled induction motors shown in the illustration above.

Airtronics MANUFACTURING CO.

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If you were buying masterpieces of art, you would be well advised to obtain the opinion of an expert to make your selections. Experience is also required in the specification of plastic molding.

We make no claims for Da Vinci techniques, or the superlative craftsmanship of the old masters. We do know something about the art of plastic molding—the right material for the job, design and construction to meet all functions of the application, consistent high quality, fine finish, etc. And for your post-war developments, MACK MOLDING maintains three completely equipped plants — Wayne, New Jersey; Arlington, Vermont; Waterloo, P.Q., Canada. Address inquiries to Mack Molding Co. Inc., 120 Main Street, Wayne, New Jersey.

Here is the well-equipped plant in the sprawling Green Mountains at Arlington, Vermont. A splendid locale for futurizing . . . in trout and maple syrup . . . and plastics.

THREE STARS ...for excellence in war production

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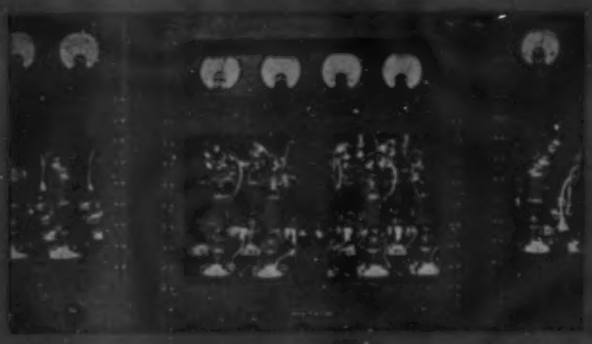
SALES OFFICES: NEW YORK CITY, CHICAGO, DETROIT, BOSTON INDIANAPOLIS & ST. LOUIS



QST-1—Life testing is an important Quality Standard test at United. It is a strictly observed procedure whereby life expectancy is controlled in "run-of-production" tubes.

QST-2—A unique test is applied to every United tube to assure noise-free operation.

Who sets the *Quality Standard* FOR TRANSMITTING TUBES

QST-3—United tubes designed for very rough service have extra, built-in shock resistance proved by the severe Bump Test each tube must pass.

Brilliant United craftsmanship is steadfastly verified and maintained by skillful and vigilant testing—truly representative of daily production. For this reason every United tube must pass through a series of critical examinations that do not permit any defects, no matter how minute they may be, to escape unnoticed.

By maintaining Quality Standard Tests of the highest order United engineers and technicians have achieved recognition for leadership. To engineers everywhere, the name United is the *trusted* standard by which other transmitting tubes are judged and measured.

For every electronic application including radio communication, physiotherapy, industrial control and electronic heating, standardize with tubes that are *the* Quality Standard. "Tube up" with United.

Order direct or from your electronic parts jobber.

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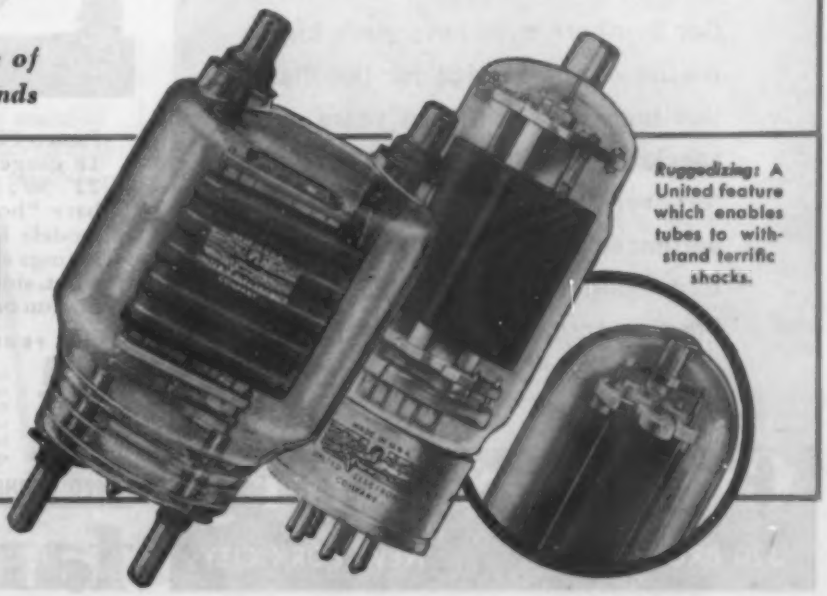

Ruggedizing: A United feature which enables tubes to withstand terrific shocks.

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NEWARK, 2 NEW JERSEY

Transmitting Tubes EXCLUSIVELY Since 1934

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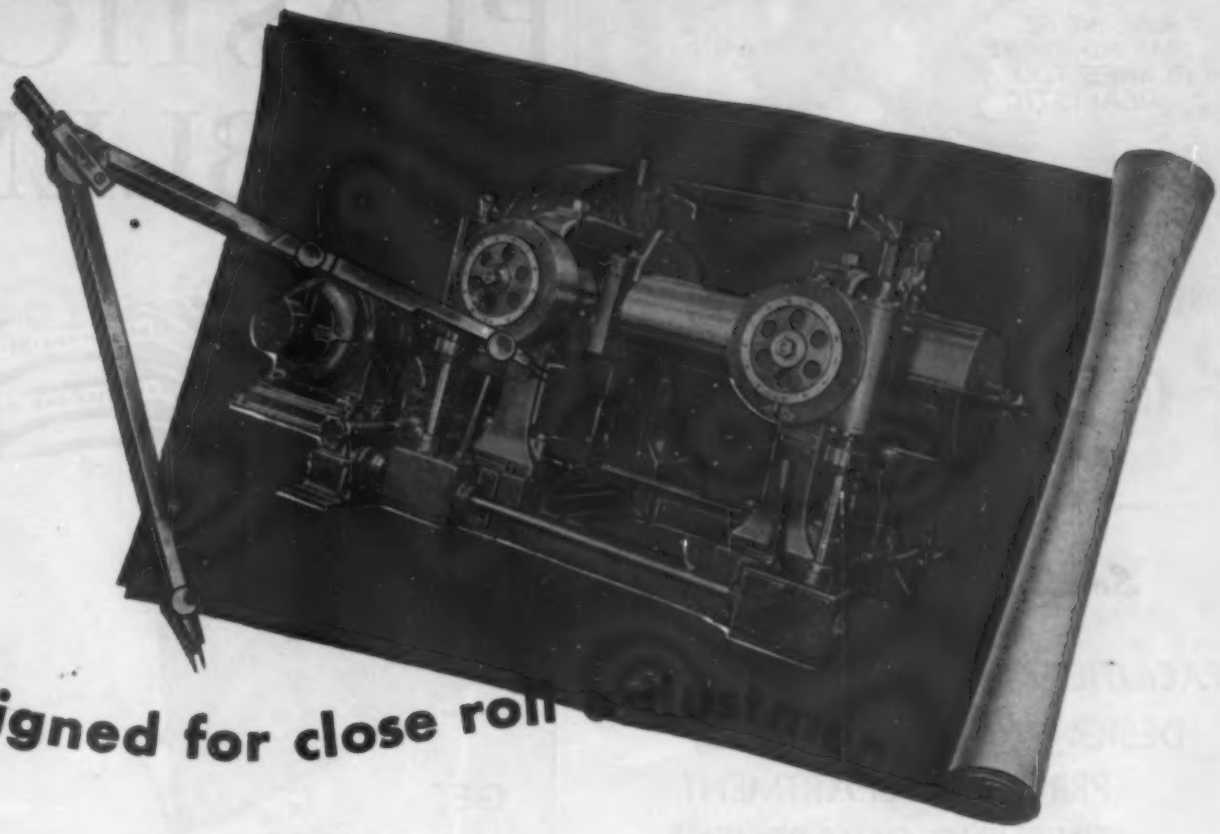

designed for close roll

Designed specifically for converting resins into plastics, this 18" x 42" mill has motor-operated roll adjustment for quick and accurate control of gauge while the batch is on the mill. The vernier dial indicators show movement of the front roll in thousandths of an inch.

Clutches which engage the worm drive for each screw allow adjustment of either end of the roll separately or both ends together. A pull-back attachment permits movement of the roll in both directions.

To prevent corrosion of the surfaces which come in contact with the stock, the chilled iron rolls are chrome-plated and the guides are made of stainless steel. The rolls are chamber-bored and fitted with stuffing boxes and interior pipes for steam circulation. The guides, which are adjustable automatically with the movement of the front roll, have a ratchet-operated adjustment to raise them vertically. This permits cleaning of the rolls under the guides as well as the undersides of the guides themselves.

Other features of the mill include water-cooled, full bronze-lined journal boxes, flood-lubricated by continuous circulating system . . . cut spur drive and connecting gears running in oil bath . . . and a right angle reduction gear drive unit which makes a compact installation in minimum floor space.

Similar *designed-for-the-job* mills are available in a complete range of sizes, from 8" x 16" for the laboratory up to 28" x 84" heavy duty mills for the factory. Write for complete information.

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IF YOU HAVE A PLASTICS PROBLEM

GET THIS FOLDER...

This handy reference Folder File serves you as a permanent reminder of our plastics engineering and molding facilities. To benefit most from plastics, consult with us early—in the design stage of your product. We shall be glad to make recommendations for plastics applications to your post-war products. Send today for your copy of Folder File MP6.

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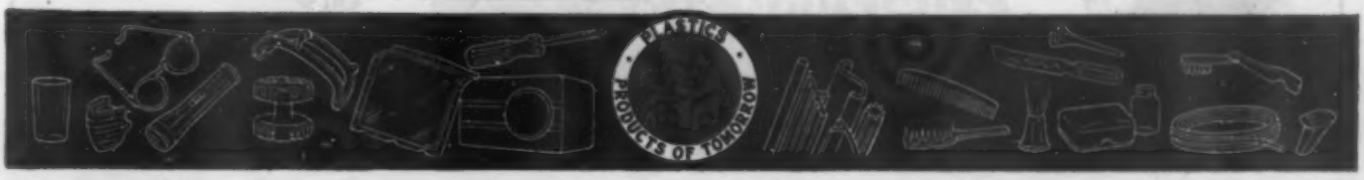
is a beautiful word. Merely to mention it brings visions of wonderful things: Children at play; men fishing, gardening, relaxing; mothers' eyes and hearts smiling; everybody happy.

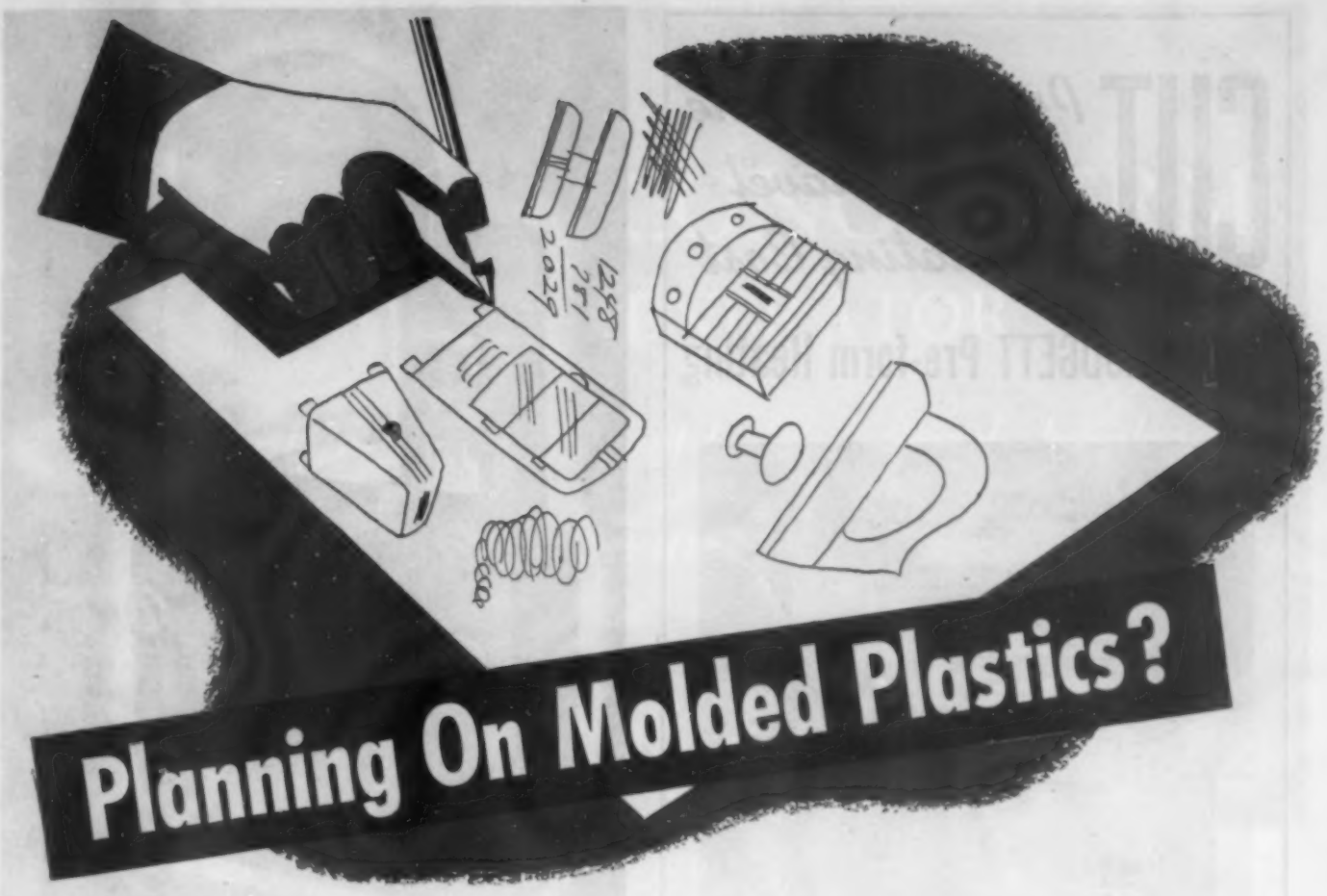
To fight for peace is such a paradox. Yet that is what we fight for! We look forward to seeing *the pendulum swing fast towards Victory and Peace!*

★ All our manufacturing skill and power are now being directed to help bring Victory and Peace. When that day comes we will then be able to direct our activities to peace-time production. We eagerly anticipate serving you with your peace-time plastic needs.

Joseph Davis PLASTICS CO.

ARLINGTON, N. J. *Formerly The Insel Co.*





Planning On Molded Plastics?

● Many postwar ideas now growing into more finished form in engineering and drafting rooms will call for molded plastic parts.

For these, General Industries offers the services of its molded plastics division.

Please get us right. We make no pretense at *designing* your molded plastic parts. You know that job better than we ever hope to.

But, we can tell you whether it's a practical molded plastic job. We can help you select the right plastic compounds—and in many cases can suggest minor changes or refinements resulting in better parts, delivered faster or more economically.

This "know-how" extends through our mold-making and processing divisions. Small parts or large ones are carefully and skillfully engineered through the intricacies of mold-designing, so that when they leave the molds they are accurate in dimensions and finely finished.

Of course, we have the necessary machines for the molding of large or small work, in any quantities, by compression, transfer or injection processes. And we keep our delivery promises.

So, if you are planning postwar products that include molded plastics, keep in touch with General Industries. Right now, we're working 100% for Uncle Sam, but when the end of that is in sight, we'll be glad to work with you.

THE GENERAL INDUSTRIES COMPANY

Molded Plastics Division • *Elyria, Ohio*

Chicago: Phone Central 8431
Detroit: Phone Madison 2146
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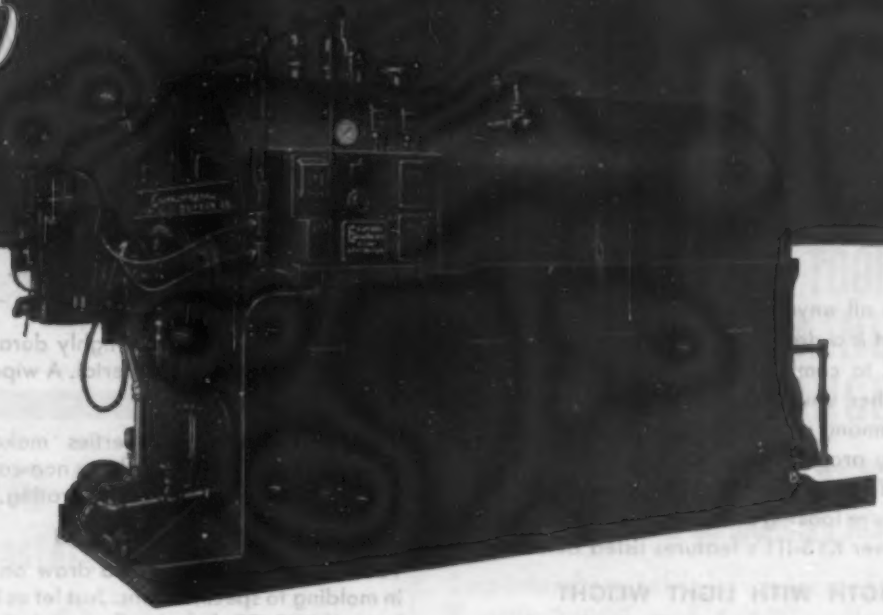
MOLDED PLASTICS

ARMY E NAVY

Dutton ECONOTHERM
STEAM GENERATOR

Automatic! Compact! . . . and backed by 65 years experience



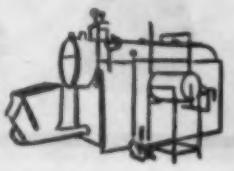
For over half a century Dutton has been a leader in engineering advancements of steam applications for processing, power and heating — this skill and "know how" is combined to make the Dutton Econotherm Steam Generator unsurpassed in performance and economy of operation and maintenance.

In one modern, streamlined, entirely self-contained unit the Dutton Econotherm will give you twice the power in half the usual space. So completely packed that your only installation costs are connecting fuel, water and steam lines — a saving of at least 20%. So ingeniously automatic that you are guaranteed perfectly balanced performance, positive water level and maintained steam pressure with a minimum of supervision.

The exclusive Dutton designed Induced Draft System insures uniform temperature immediately on firing and meets steam withdrawal without variations in pressure or changes in water level. All gases are scavenged with maximum fuel utilization, using only a pipe to carry flue gases through the roof.

The Dutton Econotherm for either gas or oil firing, is designed to meet all requirements of capacities up to 150 H.P. — overall efficiency of 80% is guaranteed. Write for full information, stating your application and requirements.

DUTTON ECONOMIST HIGH PRESSURE BOILERS



Dutton

DUTTON AUTOMATIC VERTICAL BOILERS

PRESSURE VESSELS • HEAT EXCHANGERS • CONDENSERS

THE C. H. DUTTON COMPANY • 618 GIBSON STREET • KALAMAZOO, MICHIGAN

wonderful watchdog— BUT...

Although he's all anyone could ask for in strength, Big Boy's weight *is* a drawback. He wasn't planned as KYS-ITE is . . . to combine great strength with light weight, plus other unusual properties that mark this thoroughbred among plastics.

By combining properties found in no other type of material, KYS-ITE broadens the scope of designers and engineers. If you're looking ahead to postwar products, why not look over KYS-ITE's features listed below?

GREAT STRENGTH WITH LIGHT WEIGHT

Preformed before curing, an even distribution of phenolic resin on interlocking fibres results in great tensile and compressive strength with impact strengths up to 5 times that of ordinary plastics.

WIDE RANGE OF SHAPES

Complicated pieces with projections and depressions, large or small shapes and sections — all these and more, too, are molded successfully in KYS-ITE.

KYS-ITE CAN "TAKE IT"

Unusually durable and resistant to abrasion, impervious to mild alkali and acid solutions.

INTEGRAL COLOR

KYS-ITE's lustrous finish is highly durable; the color is an integral part of the material. A wipe and it's bright!

NON-CONDUCTOR

KYS-ITE's dielectric properties make it invaluable where safety is a factor. Also a non-conductor of heat. Non-resonant and non-reverberating.

COMPLETE SERVICE TO YOU

You are cordially invited to draw on our experience in molding to specifications. Just let us know your problems. If KYS-ITE doesn't offer a solution, we'll tell you what companies might help you. Production scheduled as orders arrive. Why not get in touch today?

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KEYES
MOLDED PRODUCTS

KYS-ITE articles indicating the range of items we mold to specifications and deliver complete, ready for use.

KYS-ITE

The Long-Fibred Wood Pulp Filled Phenolic Resin Plastic Pre-formed Before Curing

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three machines in one . . .

This low-cost DURO Router-Shaper-Carver can be converted from one use to another in a few seconds

An ideal machine for these quick-changing times—when the ability to shift rapidly and economically from one set-up to another is vital.

Here is an unusually flexible machine that can be used for routing, shaping and carving wood, metal or plastics. Combines high speed (20,000 R.P.M.) power (1200 watts at the spindle) and solid, heavy construction that gives smooth, vibrationless cutting. Is extremely flexible—can be transformed quickly into a Shaper or Carver. Standard equipment handles 1/4", 5/16" and 3/8" bits for routing—5/16" and 1/2" bore shaper cutters—and all standard cutters for carving. Has many special features including: Specially designed G. E. Universal Motors, New Departure Precision ball bearings, precision machining throughout; Table can be instantly adjusted to any height without holding foot pedal. Chuck is part of spindle and holds adaptor and cutter close to work, thus preventing whip. Many other exclusive features. Unusually low priced.

Available on Priorities Only

SEND FOR CATALOG—giving full specifications and prices on the DURO Shaper-Router-Carver—and other DURO quality Machines including Drill Presses, Circular Saws, Band Saws, Flexible Shafts, Lathes, Sanders and Electric Drills.

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Excellent For Use On Irregularly Shaped Parts

Touching Up Production Setups Without Disassembly

In Tool, Die, Mold and Patterns Depts.

Finger-tip control . . . plus a wide variety of accessories . . . means precision workmanship, unlimited adaptability.

Here's versatility plus in any man's language. Let Foredom solve your production problems too. Pencil-size handpieces for the hard-to-reach places. Larger, ball-bearing handpieces for the heavier jobs, all quickly interchangeable. Flexible shafts which really ARE FLEXIBLE.

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1. For de-burring, grinding, finishing, polishing and other light production jobs—particularly valuable on irregularly shaped parts.

2. In tool and die departments, for grinding, finishing and touching up dies, molds, jigs, etc.

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THOUSANDS OF PLANTS USE FOREDOMS, including Ford, General Motors, Chrysler, Nash-Kelvinator, Jack & Heintz, Sperry Gyroscope, Bendix, Westinghouse, etc.

Send coupon for a copy of our new Catalog No. 49, showing the complete line of Foredom Flexible Shaft Machines and Accessories.

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Please send me your new Catalog No. 49, showing the different uses of Foredom Flexible Shaft Machines.

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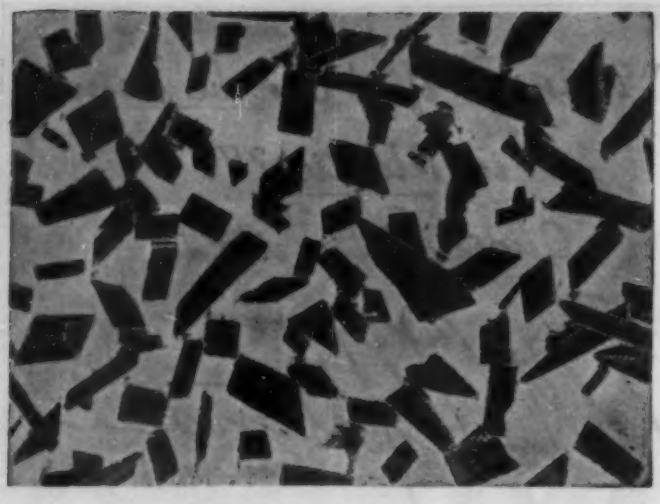

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Helmet Liner Scrap

The material used for the plastic liners worn inside steel combat helmets, constitutes an excellent low-cost molding compound of the phenol-formaldehyde type. We have available a large stock of this scrap cut to proper size. Let us give you further details as to how it is being used. The range of work is quite surprising, far beyond the original application to comparatively simple articles such as trays.

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FILFLOC Pure cotton flock of surprising cleanliness and uniformity.

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"C.A." Grade pearl essence, specially developed for use with Cellulose Acetate moulding powder.

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We have the experience, the craftsmen, the engineering skill and the facilities to give you the best for competing in postwar markets.

NOW is the time to bring or send in your blueprints or a sample product for all postwar plastic plans. Or ask for a Continental representative to call.

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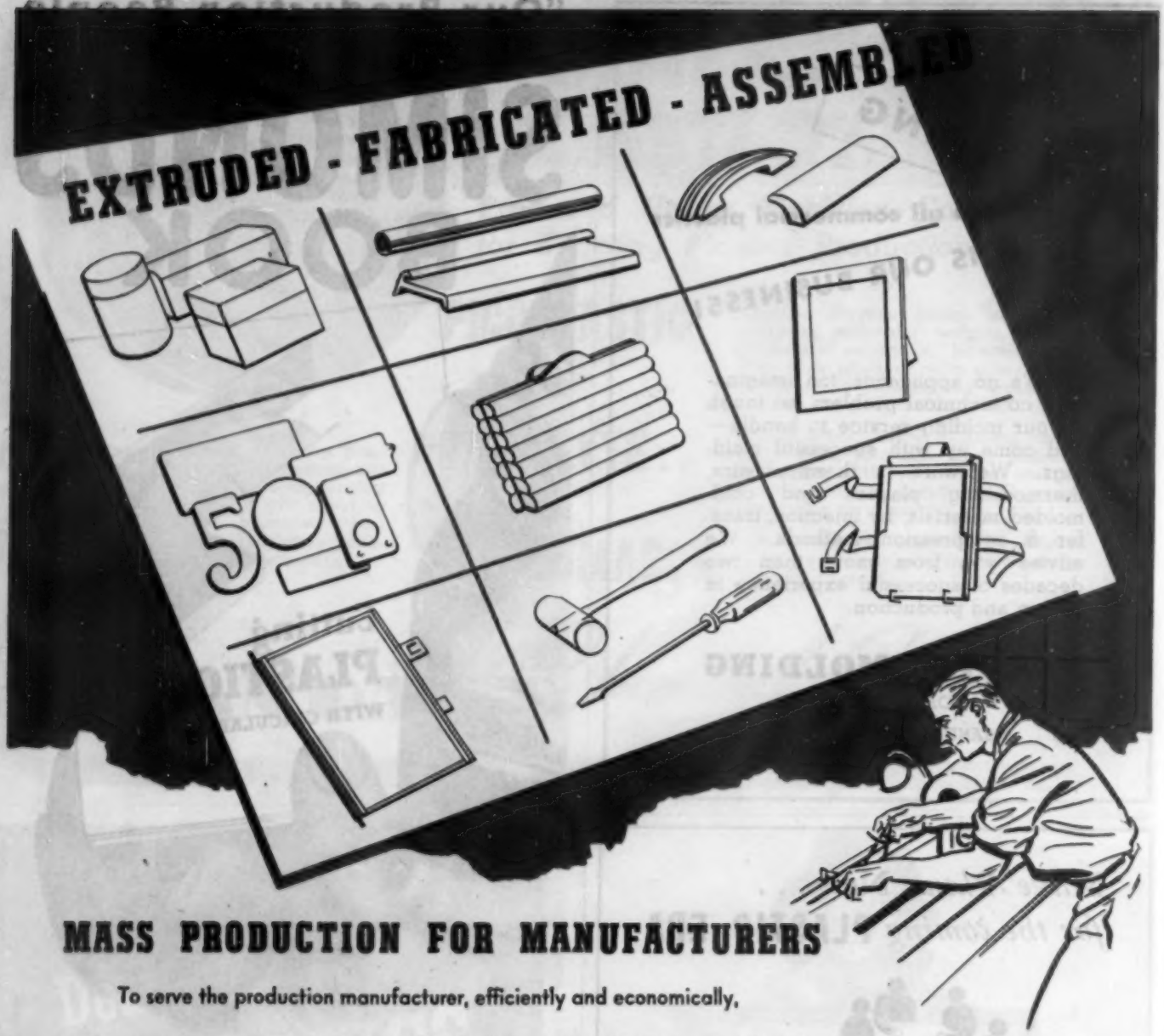

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WANTED: THERMOPLASTIC SCRAP or rejects in any form, including Acetate, Butyrate, Styrene, Acrylic and Vinyl Resin materials. Submit samples and details of quantities, grades and color for our quotations. Reply Box 508, Modern Plastics.

WANTED: PLASTIC SCRAP OR REJECTS in any form. Cellulose Acetate, Butyrate, Polystyrene, Acrylic, Vinyl Resin, etc. Also wanted surplus lots of phenolic and urea molding materials. Custom grinding and magnetising. Reply Box 318, Modern Plastics.

FOR SALE—1 Worthington Hyd. Pump 1 x 6, 5 GPM 6000 pressure M.D. 1 Set 18" x 36" compounding rolls. 1—14"x 24" Press, 9" ram; 4—24" x 55" steel cord Heating Platens; 4—W. & P. Mixers; 4—Semi-Automatic 100-ton Hydr. Presses, platen area 20" x 36"; Allen 6" Tuber; Dry Powder Mixers; Pulverizers, Grinders, etc. Send for complete list. Reply Box 447, Modern Plastics.

PLEXIGLAS and LUCITE SCRAP WANTED. Interested in small and large quantities of clean, irregular-shaped flat pieces, strips, rods and other cut-offs. All thicknesses; masked and unmasked. Kindly describe fully, stating quantity available. Box 1210, Modern Plastics.

WANTED: Small or medium sized plastic molding plant with either hydraulic extrusion or injection equipment with or without tool shop. Advise full details. Reply Box 788, Modern Plastics.

PRODUCT DESIGN ENGINEER—Graduate architect or industrial design engineer, under 35 years of age, to initiate and develop new consumer product designs in glass. Should have manufacturing experience and ability to coordinate his work with Sales, Production and Research departments.

Here is a real opportunity to join America's leading glass manufacturing company. This is a new position, with excellent prospects for the man willing and able to do creative work. If not now engaged in essential war work, write Personnel Department, giving complete description of education, professional experience, draft status. Enclose recent photograph. Salary commensurate with abilities. All replies confidential.

CORNING GLASS WORKS
Corning, New York

CANADA, A Large Post War Market—Wide-awake, reliable Canadian sales organization, having connections with wholesale hardware, chain and department store trade, can accept representation for additional factory requiring Canadian factory agents operating on commission basis, providing line does not conflict with present representations. H. HACKING CO. LTD., 144 Water Street, Vancouver, Canada (Est. 1916). Canadian Branches from Coast to Coast.

WANTED: Cellulose Nitrate sheets or strips of .060 to .070 thickness, suitable for stamping blanks from ¾ inch to 3 inch diametes. Prefer transparent but can use some laminated in colors. Send samples with quotations to Florida Supply House, 415—12th St., Bradenton, Florida.

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We are distributors of small plastic items, such as TOYS, NOVELTIES, CIGARETTE CASES AND BOXES, MATCH CASES, SMALL HOUSE WARES, TOWEL BARS, SOAP TRAYS, TUMBLERS AND TUMBLER HOLDERS, etc. We have a good following in chain variety stores, Drug Stores, Stationery Stores and the like, and are capable of obtaining large distribution. Interested in all types of small plastic items. Invite you to send us samples and quote best prices. Address PLASTIC MERCHANDISE, P. O. BOX 81, MORGANTON, N. C.

IN THE MARKET FOR: Stainless Steel or Nickel Kettles, Vacuum Pan, Preform Machine and Mixer, Hydraulic Presses. Reply Box 825, Modern Plastics.

ARE YOU planning on going into plastics after the war or are you in need of an experienced plastics man at this time to help with your production problems? I am qualified to handle all phases of plant production. Have many years experience in handling production problems, ability to organize. Will gladly furnish record of past experiences. Available immediately. Location unimportant. Reply Box 1251, Modern Plastics.

FOR SALE—Two Plastic Press Heaters KRD430 6000 W—220 V Oil Heaters with Circulating Pump and Motor. Taylor temperature control 100°-600° F. Compact Unit. Superior Plastic Co., 426 N. Oakley Blvd., Chicago 12, Illinois.

PLASTIC COATINGS CHEMIST, B.S., having wide experience handling corrosion problems and formulating plastic coatings. Extensive development of vinyl types. Capable of assuming complete charge. Minimum $4,000, midwest preferred. Age 31, married, 2-A. Immediately available. Reply Box 1252, Modern Plastics.

EXECUTIVE MECHANICAL ENGINEER—19 years experience in Rubber and Plastics. Thoroughly conversant with Production, Engineering, as well as Management and Labor problems. Expert on heavy machinery such as Banburys, Mills, Calenders, Presses, etc. Now employed in Wire Plant. Minimum salary $8,000. Location immaterial. Box 1253, Modern Plastics.

IS YOUR PRODUCT SOLD IN CANADA?

Two top executives of AA-1 Corporation have set up their own coast-to-coast sales organization across Canada, and are prepared to assume one more high calibre line to round out their merchandising programme. Results assured if you have the product. Reply Box 1254, Modern Plastics.

WILL MANUFACTURERS who have new ideas and patents in connection with articles made of Thermo Plastic materials, which can be produced through the injection Moulding process, communicate with us with reference to post-war business, as we are prepared to produce these articles in the United Kingdom for Europe and the Overseas Market, without clashing with the original manufacturers. O. & M. Kleeman Ltd., Mappin House, 156/162 Oxford Street, London W.1., England.

VETERAN, age 30, experienced jewelry salesman. Desires line with reputable firm to sell to Retail Jewelers and Department Stores in New York and vicinity. Salary or drawing against commission. Reply Box 1255, Modern Plastics.

FOR SALE: H.P.M.C. Press 318 tons 18" ram, 30" daylight with 7 steel platens 26" x 44", 2½" thick, complete with valves, piping, oil reservoir, temperature control, condensers and flexible platen hose; operated by 37 G.P.M. pump for quick closing and 1½ G.P.M. pump with hand wheel control valve to maintain holding pressure 750# to 3000#; press is complete for immediate operation. Several 150 gal. W. P. mastadon and other type mixers. Two new 1½" 3000# hydraulic Bellfield valves. One 8 cylinder hydraulic pump, capacity 250 C.I.P.M. with hand wheel control valve to maintain holding pressure 0 to 3000#; manufactured by New York Air Brake Co.; new in original crate. 500# No. 7046 Resyl. 450# Melmac S-72. Write Box 1256, Modern Plastics.

VETERAN seeks job as contact man or salesman in Plastics Field. Some knowledge of Plastics. Reply Box 1262, Modern Plastics.

FOR SALE: Plastics fabricating plant with good record of earnings. Products well diversified with good sales organization. 10,000 sq. ft. of floor space in present plant and so located that expansion can readily be made. Present owner has other businesses that make sale desirable. Reply Box 1257, Modern Plastics.

WANTED: General Manager for plastics fabricating plant of medium size that will also make some financial investment in business. Company is well organized for post war business. Reply Box 1258, Modern Plastics.

WANTED for Mold and Material Testing Purposes 6 or 8 oz. Injection Mold Machine. The Machine will be used for Experimental Purposes for the Advancement of the Plastics Industry. Thomas Engineering Company, 24 Scott Street, Newark 2, New Jersey.

WANTED

EXPERIENCED TOOL ROOM SUPERINTENDENT—By well established Molding Company producing plastic buttons and custom molded articles. Applicant must be qualified to take full charge of tool production on both compression and injection work. Button mold experience especially desirable. State experience, age, education and availability. Reply in detail to Box 1259, Modern Plastics.

EXPERIENCED Injection Molding Set-Up Man on Lucite, Styrene and Acetate, seeking Foreman's position. Reply Box 1260, Modern Plastics.

WANTED

Injection molds, any size. Advise full details and send sample of molded product.

Reply Box 1261, Modern Plastics.

FOR SALE: 14 complete high and low pressure Dunning & Boschert Lever Valves, suitable for 75 to 450 ton presses, operating at pressures of 4,000# and less.

AMERICAN INSULATOR CORPORATION
New Freedom, Penna.

SALES ORGANIZATION with show rooms at 200—5th Avenue wishes a line from a manufacturer. We are thoroughly familiar with the plastics field and are now selling nationally known items to jobbers of Toys, Drugs, Hardware and Notions, Chain and Dept. Stores. Commission Basis. Reply Box 1263, Modern Plastics.

WESTERN NEW YORK plastic manufacturer and molder wants chemist or chemical engineer for general research and pilot plant operation. Give full details first letter. Reply Box 1264, Modern Plastics.

MEANS OF FASTENING of leather, cloth, etc., to plastics, metals, etc. Patent No. 2311326 license or outright sale. Address Box 1265, Modern Plastics.

FOR SALE: 10" x 18" Two Roll Mixing Mill; Ball and Jewel Rotary Cutter; Royle No. 2 "Perfected" Tuber. Brill Equipment Company, 225 W. 34th St., New York 1, N. Y.

ARGENTINA and URUGUAY. Plastics specialist, ex-producer of local emergency-molding powder, desires to represent manufacturers or exporters of all kinds of molding powders and laminated plastics. Special interest for Urea-adhesives for plywood and molding machinery. First-class connections on local market. For details write to Edgar Dreyfus, Uriarte 2425, Buenos Aires, Rep. Argentina.

MOLDING FOREMAN. A Southern New England concern needs a general molding department foreman experienced in injection, transfer, and compression molding. Technical background preferred. Good future, salary. Write giving complete plastic and technical background. Box 1267, Modern Plastics.

WANTED—Color matcher for coated fabrics. Technical training helpful but not essential. Observe W.M.C. rules, P. O. 478, Passaic, New Jersey.

WANTED—Extruding, fabricating or molding plant, or part ownership therein, or partner to begin such a business anywhere in United States. Have production ideas and excellent distribution connections. Write full details in first letter. Reply Box 1268, Modern Plastics.

RECORD FACTORY EQUIPMENT—Everything for the manufacturing of records also plastic compounds for molding records and plastics. Poinsettia, Inc., Recording & Record Manufacturing Consultants, 98 Cedar Avenue, Pitman, New Jersey.

FINE-HOLE CARBIDE DIES

for thread-, extrusion-, coating-, etc., from .004" on—price p. die, mirror-finished, in amounts of

50–99	100–199	over 200
$ 6.00	5.35	5.00

Shape-dies, intricate dies, extrusion any size, in carbide and steel—we supply, develop and design.

WOPIS INDUSTRY LABORATORY
1781 E. 15 Street, Brooklyn 29, N. Y.

SPENCE-RICOLO
PRODUCT DESIGN & STYLING
677 Fifth Ave., New York 22, N. Y.

WANTED

2—34" Mixing mills, 1—40" mixing mill, 1—36" Cracker with drives and motors, 1—3 roll Calender 60" goods, 1—3 roll Calender 57" goods, Extruders 3½" to 10" Royle Preferred. Reply Box 1229, Modern Plastics.

WANTED, Mechanic Hydraulic—one who fully understands rebuilding and installation of all Hydraulic Equipment. Permanent position. Reply Box 1248, Modern Plastics.

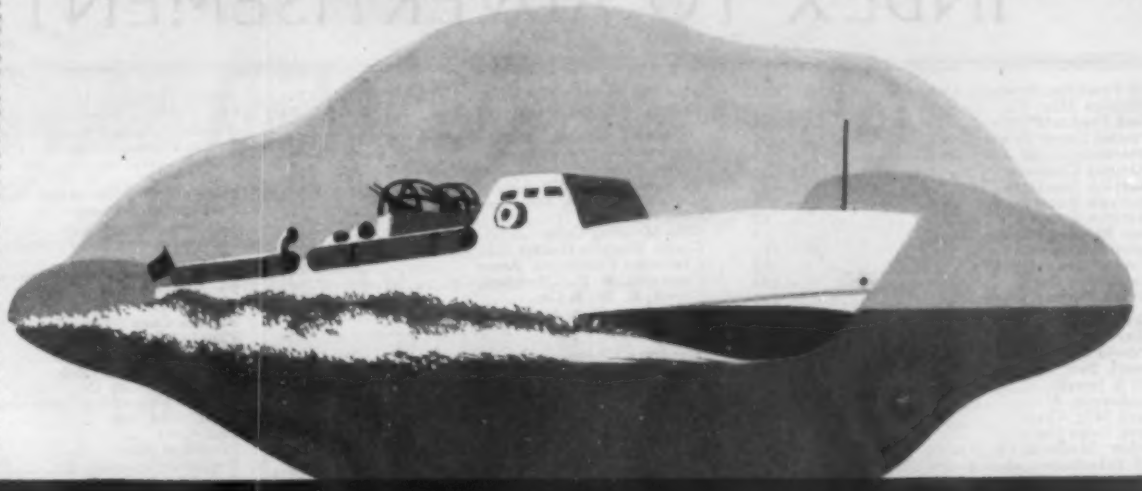
FOR SALE: Hydraulic Presses, 600 ton Watson Stillman downward double acting ram, platen 24" x 24", 1—36" x 36" 12" ram, 200 ton all steel construction, 8—20" x 20" 10" rams, 1—24" x 24" 12" ram, 1—32" x 26" 14" ram 400 tons, 4—12" x 12" 7¼" rams, 3—12" x 12" 8" rams, 1—32" x 50" 15" ram, 4 openings, 1—26" x 45" 10" ram, 2—15" x 15" 8½" rams, 4 Hanna Hydraulic Cylinders, Model HP 14, 30 ton capacity, 8" dia. 36" stroke. PUMPS: Robertson Triplex 5 GPM 5000 lbs., Watson Stillman 4 plunger box type 2 GPM 4000 lbs., Deane Triplex 4 GPM 2500 lbs., HPM Triplex 1½ GPM 2500 lbs., Gould Triplex 12 GPM 1250 lbs., 4 plunger vertical 4 GPM 2250 lbs., National Triplex 3 GPM 4000 lbs., Hele Shaw JLP 12, 44 GPM 1200 lbs., HPM Triplex 1¼ GPM 2000 lbs. on high, 16 GPM 400 lbs. on low, V Belt Drive. ACCUMULATORS: Hydro-Pneumatic 4½" dia. plunger by 27" stroke with By-Pass Valve, Weighted type 5" dia. by 6' stroke. EXTRUDERS: No. 2 Royle Perfected; Mills, Calenders, Mixers, etc. Advise your requirements. HIGHEST PRICES PAID FOR YOUR USED EQUIPMENT. Universal Hydraulic Machinery Company, 285 Hudson Street, New York City 13.

DO YOU NEED REPRESENTATION IN THE NORTHWEST? Aggressive Sales Organization covering Washington, Oregon, Idaho, Montana, Utah, and Alaska wants stock-mold lines for now and post-war. Reply Box 1266, Modern Plastics.

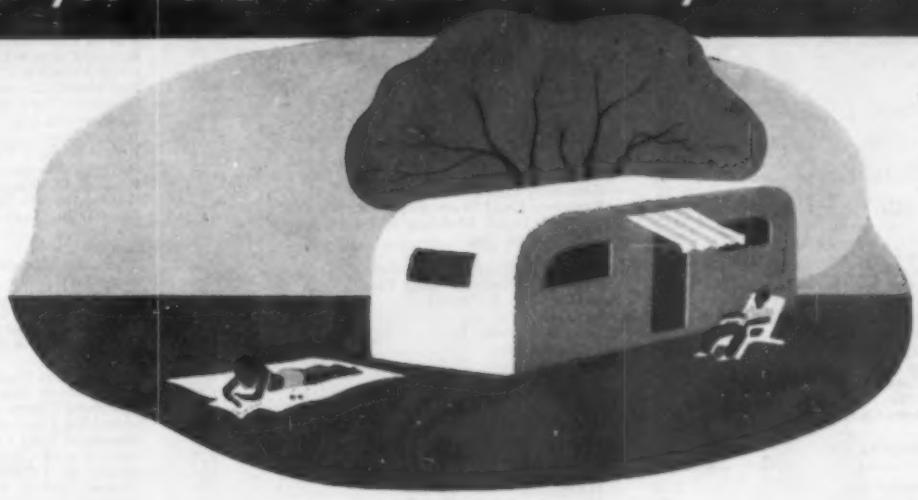
ATTENTION—PLASTIC MOULDERS
INJECTION or COMPRESSION

At present we represent one moulder for whom we created and designed an item for which more than a million dollars worth of orders was obtained. We would like to represent one additional moulder. We sell chain stores from coast to coast. Work only on commission basis. Have another idea for which we believe a like amount of business can be obtained. Have own showroom—5th Ave. location. Box 1215, Modern Plastics.

FOR SALE: Watson-Stillman 225 ton Transfer Molding Press; Farquhar 150 ton; Molding Presses 50 to 250 tons: 36" x 36", 30" x 40", 16" x 16", 12" x 12", 30" x 36", 24" x 36", 22" x 24", 25" x 36", 48" x 26"; 40 ton Broaching Press; 400 ton Extrusion Press. Horiz. 4 Plgr., 1" & 2" x 4", high & low pressure. W.-S. 1¼" x 12" Horiz. 4 Plgr. 30 GPM, 3500 lbs. H.P.M. 1¼" x 6" vert. Triplex, 10 GPM, 2700 lbs. 2—Oilgear Pumps, 13 GPM and 1250 lbs. Wat.-Farrel 1¼" x 4", Vert. Triplex, 6 GPM, 3000 lbs.; Goulds 2¼" x 8" Vert. Triplex 30 GPM, 1600 lbs.; Elmes 1" x 4" & 1¼" x 4" Horiz. 4 Plgr., 5 to 8 GPM, 4500 lbs. & 5500 lbs. Rumsey 4½" x 8" vert. Triplex, 65 GPM, 900 lbs.; 10 HP Horiz. 1¼" x 4" Triplex 6 GPM, 3000 lbs.; 10 New Vickers Oil Pumps, 28 GPM, 1000 lbs.; Hydr. Steam Pumps up to 150 GPM; Hand Pumps; Low Pressure Pumps from 150 to 600 lbs.; Hydr. Accumulators; New Vickers 1¼" Oil Relief Valves; New Vickers ¾" Flow Control Valves; Royle #2 Extruder; ½" & ⅝" Preform Tablet Machines; Heavy Duty Mixers; Ball & Jewell #1½ Rotary Cutter. Ball Bearing Roller Conveyor. Grinders, Pulverizers; Gas Boilers, Tanks, etc. ONLY PARTIAL LISTING. WE BUY YOUR USED MACHINERY. STEIN EQUIPMENT CO., 426 BROOME ST., NEW YORK 13, N. Y. CANAL 6-8147.



Whether you build PT Boats or Luxury Trailers . . .



.....your product can be improved with a Kimpreg* Surface

A revolutionary new alloy-like material is achieved by fusing to plywood's surface a cured plastic skin of KIMPREG. This resultant material is not a plywood in the ordinary sense, not a conventional plastic laminate. It is a brand new, better structural medium with countless applications in many products—including, very probably, those *you* plan for post-war production.

With KIMPREG, plywood is converted into an improved substance which can be machined, formed and fastened like ordinary wood—yet has a plastic's smooth, tough surface and beautiful, permanent, paintless finish.

KIMPREG adds the following advantages to plywood: 1) increases durability and flexural strength; 2) provides resistance to moisture and vapor; 3) armor-plates against extreme abrasion; 4) diminishes grain-raising effects; 5) makes the material scuffproof, splinterproof, snag-resistant; 6) affords a stainproof, washable, "wipe clean" surface; 7) creates resistance to chemical action, decay, temperature-extremes, fire, vermin, and mold. Moreover, it is warm to the touch, does not have the chill "feel" of metal surfaces.

Today all KIMPREG is required for military needs, ranging from airborne "prefab" huts to glass-smooth tables for packing parachutes without snagging. Hence, the wartime color of KIMPREG is a soldierly olive-drab. Post-war, however, it will be offered in a variety of appealing hues.

Now is the time to investigate the possibilities of KIMPREG-surfaced materials for your *peacetime* requirements.

*TRADE MARK

Kimpreg
TRADE MARK

A PRODUCT OF Kimberly Clark RESEARCH

Among the users of KIMPREG are: Buffelen Lumber & Manufacturing Company; Olympic Plywood Company; Washington Veneer Company; and The Wheeler, Osgood Company; all of whom are currently producing a Douglas Fir Plywood surfaced with KIMPREG. This product is sold under the trade name of Inderon.

Send Coupon for FREE KIMPREG Book to:
Kimberly-Clark Corporation, Neenah, Wis.
MP-645

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INDEX TO ADVERTISEMENTS

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MODERN PLASTICS
Published by MODERN PLASTICS, INC
122 EAST 42nd ST., NEW YORK 17, N. Y.

The Goggle* That Stays Fog and Frost Free

In the hands of Dr. Frank W. Maurer, goggle design has undergone both novel and radical improvements, and already wide combat and industrial usage. Each time the wearer inhales, a supply of fresh air is drawn through side cavity filters held in plastic frames. Eye and skin moisture is swept out before it can form lens fog. The side cavity frames are illustrative of plastics broad adaptability — two pieces so constructed that the wearer may separate them instantly for filter replacement and snap them securely together again, just as quickly. If they suggest a plastic application in your production plans, we would like to be the first to know.

* Welco Fog Free Goggle, manufactured by H. L. Bouton Company, Buzzards Bay, Mass., distributed by Welch Mfg. Co., Providence, R. I.

FOR CUSTOM INJECTION MOULDING . . . TRY THE TRIO

Custom Injection Moulding

WORCESTER MOULDED PLASTICS CO.

14 HYGEIA STREET, WORCESTER 8, MASS.

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BAKELITE

BY THE MARK FOUR ...BY THE DEEP SIX!

GOOD NEWS THAT, from the leadsman of sailing days. Upon his soundings depended his ship's safety. Today, of course, the safety factor on land, sea, and in the air, is measured by electrical instruments equipped with crystal clear windows made from highly lustrous BAKELITE cast resin sheet BT-48-306.

The chemical formulation of BT-48-306 makes it inherently non-electrostatic. *It dissipates static charges more quickly than other transparent materials.* It serves as a shield against stray currents, thereby avoiding danger of inaccuracies in instrument readings. Windows made from this material are clearer than many kinds of glass, and are shatter- and shock-resistant.

BAKELITE cast resin BT-48-306 can be provided in a choice of colors to meet varying light transmission requirements. It is supplied with an exceptionally high lustrous finish, therefore, does not require polishing. When employed for instrument windows, it can be blanked out to the required shape and dimensions without need of subsequent machining and finishing operations. Although thermosetting in nature, the material can be *postformed* by a special technique to provide domed and curved surfaces.

Write for Booklet 15-H, which provides detailed information on the properties, uses, and fabricating techniques developed for BT-48-306, and other cast resin products.

TRADE MARK

BAKELITE CORPORATION
Unit of Union Carbide and Carbon Corporation
UCC
300 MADISON AVENUE, NEW YORK 17, N. Y.

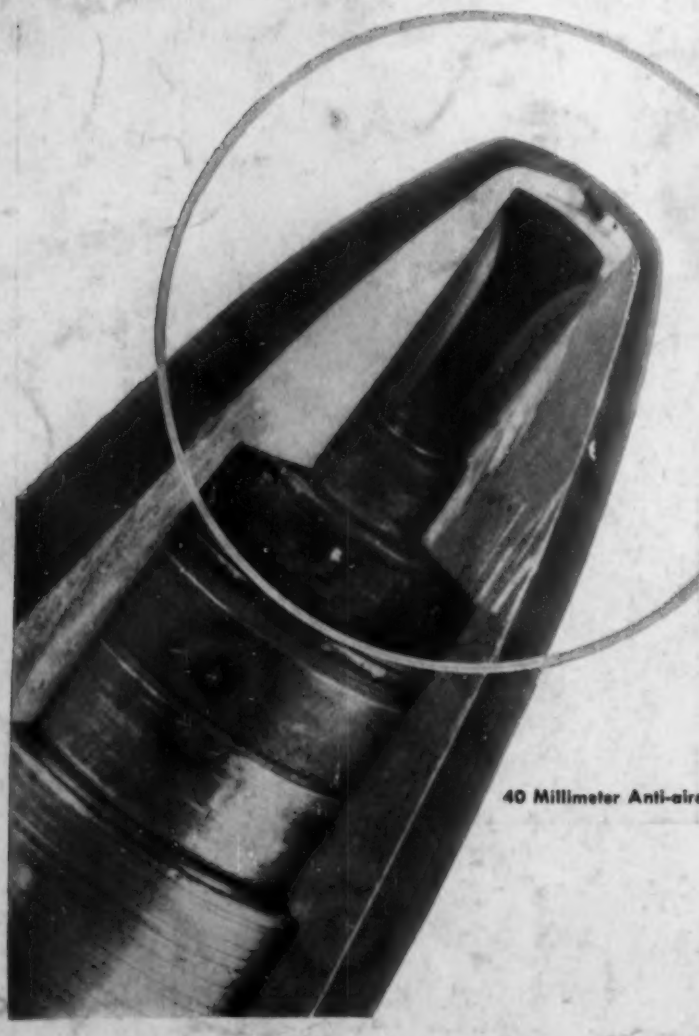
Depth gauge made by United States Gauge Company with cast resin window fabricated by Valley Manufacturing Co.

Cast Resins

Plastic pins THAT PACK A WALLOP

Somewhere in the Pacific . . . A Jap "Nell" drops out of the sun and starts her run on an American Carrier. Anti-aircraft batteries open up . . . each 40 millimeter Bofors gun sending 120 projectiles a minute to intercept—AND A PLASTIC PIN RIDES IN THE NOSE OF EACH SHELL.

Millions of plastic firing pins have been manufactured by the General Electric Company to such exacting specifications that the instant the tip of the projectile touches a plane the plastic pin is driven backwards, striking the detonator which explodes the shell. . . downing any Jap Nell, Betty, Lily or Sally.



These plastic pins are just one of the many exacting war jobs being skillfully accomplished by the General Electric Company. World's largest manufacturers of plastic parts, the General Electric Company is prepared to place at the disposal of any industry the complete facilities of its modern plastics plants and the knowledge of its experienced designers, engineers, chemists and toolmakers.

Since the General Electric fabricates all types of plastics it can and will give you an unbiased recommendation for your specific job. Write Section A–6, General Electric Company, 1 Plastics Avenue, Pittsfield, Massachusetts.

Hear the General Electric radio programs: "The G-E All-Girl Orchestra" Sunday 10 P.M. EWT, NBC. "The World Today" news every weekday 6:45 P.M. EWT, CBS. "G-E House Party" every weekday 4:00 P.M. EWT, CBS.

GENERAL ELECTRIC

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40 Millimeter Anti-aircraft Shell Fuse

PD-6